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# THE LARYNGOSCOPE.

VOL. LIII

FEBRUARY, 1943.

No. 2

## EXPERIMENTAL SURGERY OF THE FRONTAL SINUS.\*†

### THE ROLE OF THE OSTIUM AND NASOFRONTAL DUCT IN POSTOPERATIVE HEALING.

DR. THEODORE E. WALSH, St. Louis.

#### INTRODUCTION.

The changing concepts of nasal physiology emphasized in recent years by Proetz,<sup>1</sup> Hilding<sup>2,3</sup> and others have led to investigation of cilia in sinus drainage. Hilding made especially valuable contributions to this subject with experiments in dogs<sup>4</sup> and in his observations on the effect of interference with the ostium maxillare in the rabbit.<sup>5</sup> He found that when a portion of the lining mucosa of the antrum was disturbed, for instance by elevation and removal of a portion, infection resulted in that part of the sinus distal to the ostium and pus accumulated therein; this occurred in spite of careful aseptic surgical technique. Furthermore, when he destroyed the ostium of the antrum, the whole sinus became infected and filled with pus. Such infection was frequently extensive and involved the subcutaneous tissues of the nose and face. I repeated Hilding's experiments with substantially the same results.

These experiments suggest that the drainage of a sinus is dependent upon the integrity of the mucosa and particularly of the epithelium in and adjacent to the ostium.

If this is true, it affords a possible explanation for the frequent failure of the classical surgical procedures advocated

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for treatment of chronic frontal sinusitis. The objective in such procedures is the promotion of drainage from the sinus, by enlargement of the nasofrontal duct, with or without total removal of the lining mucosa.

It seemed worthwhile to investigate the effects of interference with the nasofrontal duct and frontal ostium and to study the reparative changes which occur under these conditions.

#### METHODS.

Dogs were used throughout the study. With the animal under nembutal anesthesia a median vertical incision was made in the skin of the forehead. The superficial tissues were retracted and the outer wall of the frontal sinus exposed. The sinuses were entered with a gouge and the openings enlarged with Kerrison's rongeurs. In some instances this procedure was done with careful aseptic technique, in others with no especial precautions.

In one frontal sinus the ostium and the frontal duct were enlarged and the adjacent ethmoid cells curetted; in the other sinus, the ostium and duct were not touched, but a portion of the mucosa on the posterior wall of the sinus was traumatized.

In some instances the membrane of the entire sinus was removed and the nasofrontal duct enlarged on one side, while in the other sinus all of the mucosa to within one-fourth of an inch from the duct was removed, the duct and "Leaf" (described below) being left untouched.

The animals were sacrificed at varying intervals after this operation, and the heads were examined grossly and by microscopic section. In most instances gross examination of the sinuses was done by making a vertical section of the head after it had been frozen. For microscopic sections, the heads, fixed in formalin, were decalcified by immersion in nitric acid and celloidin sections made. Hematoxylin and eosin stains were used.

#### ANATOMY.

The frontal sinuses in dogs vary as greatly in size and shape as they do in man. The two frontal sinuses, however, are approximately the same size in any one animal. Irregu-

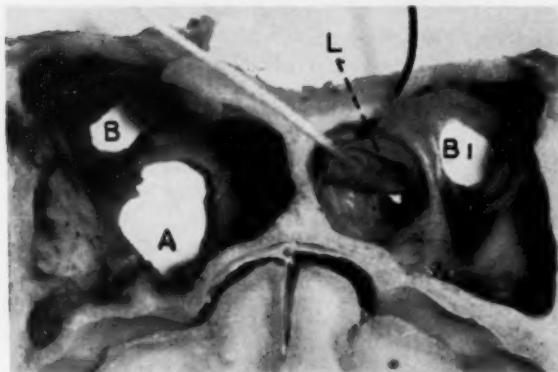


Fig. 1A. Photograph of dog's head cut in coronal section. The dog did not recover from the anesthetic. Viewed from behind. (A) operative defect of enlargement of nasofrontal duct. (B) (B-1) anterior recess of frontal sinus. The white thread is seen passing lateral to the "leaf" (L). The black thread passed medial to the "Leaf."

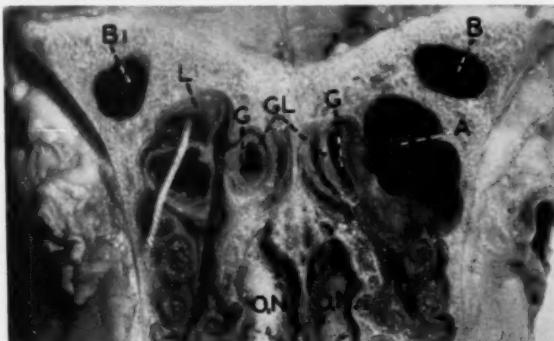


Fig. 1B. Viewed from front. White thread is seen passing into adjacent ethmoid cell. Black thread into middle meatus. (G) agger nasi cell. (O N) olfactory nerve. (G L) "Leaf" of agger nasi cell. (A) operative defect. (H) "Leaf" of frontal.

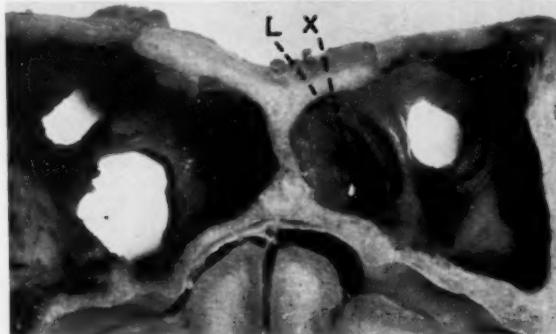


Fig. 1C. Same animal as (A) and (B) with "Leaf" (L) in place. It is seen lying close against the anterior and medial walls of the sinus. The opening (X) leads not into the middle meatus but into an ethmoid cell or an anterior prolongation of the frontal sinus.

larities in the cavity of the sinus are formed by partial septa, one of which divides the sinus into a larger, flatter, more superficial portion and a deeper, smaller, occasionally funnel-shaped part.

Lying parallel and in close approximation to the anterior and medial walls of the sinus is an interesting structure—the “Leaf.” Hilding<sup>4</sup> described this structure as lying “mesial to the ostium.” It is seen, however, that the ostium of the sinus and the nasofrontal duct lie mesial to the “Leaf” (see Figs. 1A, 1B, 1C), the base of which forms the lateral half of the ostium of the frontal sinus. Lateral to the “leaf” is an opening which leads not into the nasofrontal duct and nose but into a cell which may be an extension of the frontal sinus or may be an adjacent ethmoid cell.

Viewed from above the “leaf” entirely overlies and hides the frontal ostium and the nasofrontal duct.

Microscopically, the “leaf” is seen to consist of a thin lamella of bone covered with mucous membrane. On the surface which presents toward the cavity of the sinus the mucous membrane consists of a thin fibrous tissue stroma, containing few blood vessels and very few glands. The epithelium covering this stroma is columnar ciliated in type and has very few goblet cells. At the edge of the “leaf” a sudden transition in the character of the mucous membrane occurs. On the surface which presents toward the ostium the epithelium contains many goblet cells and the subepithelial tissues are rich in blood vessels and mucous glands (see Fig. 2); olfactory nerve fibres run in the mucosa on the duct side.

The function of the “leaf” is not known. Hilding described the flow of mucus in the sinus as dividing at the edge of the “leaf.” It is possible that the “leaf” governs the amount of mucus brought to the ostium at any one time. It may, perhaps, also act in some way as a valve to prevent air currents and infection from entering directly into the sinus. This study seems to show that its integrity is necessary for the health of the sinus.

Anterior and medial to the frontal sinus lies the agger nasi cell; this cell, as indeed all the ethmoid cells, has a “leaf” structure forming part of its ostium. The duct from the

agger nasi cell and that from the frontal sinus of the same side open into a common meatus in the nose.

#### RESULTS.

The healing following three distinct operative procedures was studied. These procedures were: 1. Enlargement of the frontal ostium and nasofrontal duct, without interference with the mucosa of the rest of the frontal sinus: this pro-

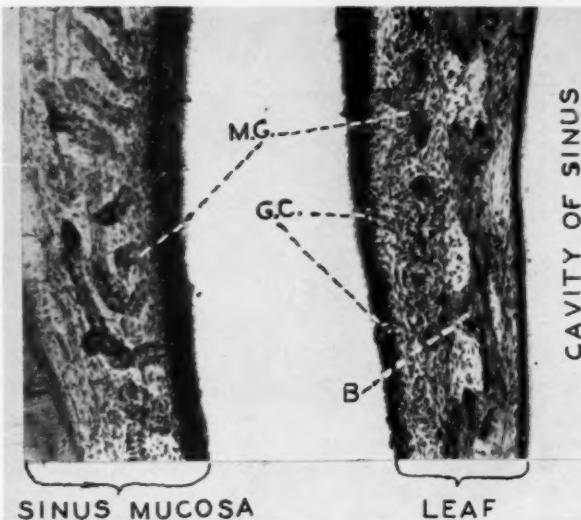


Fig. 2. Highpower (135x) of the area encircled in Fig. 5. The absence of glands and blood vessels on the sinus side of the "Leaf" is well seen. The subepithelial glands are prominent on the duct side. (B) bony lamella of "Leaf." (M G) mucus gland. (G C) goblet cells.

cedure is analogous to the intranasal frontal operation in which the objective is establishment of drainage from the frontal sinus by enlargement of its ostium and by curettage of the nasofrontal duct.

2. Radical removal of the mucosa of the frontal sinus with enlargement of the ostium and of the nasofrontal duct: this procedure is analogous to the classical radical frontal operation.

3. Radical removal of the mucosa of the frontal sinus to

within one-fourth of an inch of the ostium without interference with the ostium or with the nasofrontal duct.

#### GROUP I. ENLARGEMENT OF OSTIUM AND NASOFRONTAL DUCT.

Twenty-two sinuses, fifteen left and seven right, were operated upon in this group.

Eleven animals were operated upon under strict aseptic technique and of these, serial microscopic sections were made in seven. Of the four animals whose tissues were not sectioned, three had no pus in the sinus grossly, and one had much pus.

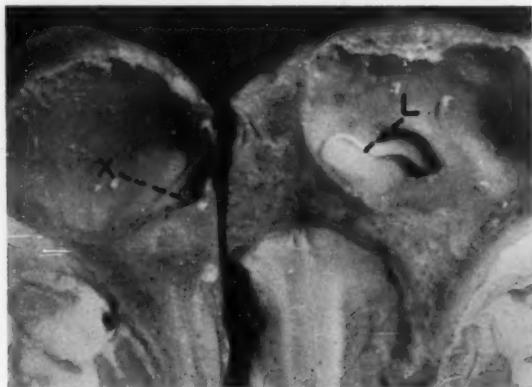


Fig. 3. Coronal section of 38-day animal viewed from behind. The "Leaf" (L) was not disturbed on the right. The "Leaf" was removed and ostium enlarged on the left. It is seen that the operative defect (compare Fig. 1), has healed except for an opening 0.25 cm. in diameter (K).

Eleven animals were operated upon with no attention to asepsis. These animals were used in the course on nasal physiology for postgraduate students, and ciliary function and the effects of drugs were observed. Following the observations, the nasofrontal duct and ostium of one side was curetted and enlarged, the other side being left intact. When the animals were sacrificed the heads were frozen, cut in coronal sections, and, after fixation, mounted as gross specimens. Of these 11 animals three showed no pus on the side of operation; the ostium was patent and the sinus clean. Two others had no pus in the sinus; the ostium of one of these was healed completely and did not communicate with the nose

or with adjacent ethmoid cells. In the other, the healing was nearly complete, a small opening only being present in a fibrous scar (see Fig. 3).

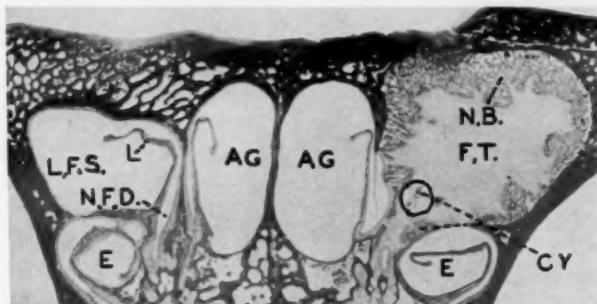


Fig. 4. Coronal section from a 26-day animal of Group 1 through the anterior part of the sinus, looking from behind. The right nasofrontal duct, "Leaf" and ostium were destroyed. New bone (N B) and fibrous tissue (F T) are seen in the right frontal sinus. Cysts (CY) are seen in the fibrous tissue. In the left frontal sinus the "Leaf" (L) is seen with the beginning of the nasofrontal duct (N F D) on its medial side. (E) ethmoid cells. (A G) agger nasi cell. (L F S) left frontal sinus.

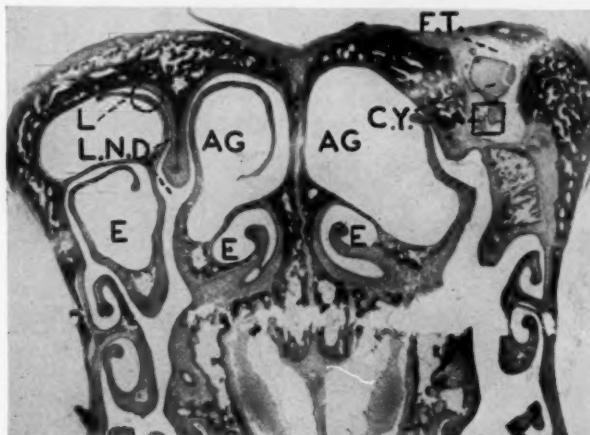


Fig. 5. Coronal section from a 63-day animal of Group 1. The section is more anterior than that in Fig. 4. The right nasofrontal duct, "Leaf" and ostium were destroyed. Cysts (CY) can be seen in the fibrous tissue (F T) filling the sinus. The left nasofrontal duct (L N D) and "Leaf" (L) are well seen. The duct lying medial to the "Leaf." (E) ethmoid cells. (A G) agger nasi cell.

The remaining six animals showed the sinus filled with pus, granulations and fibrous tissue (see Figs. 4 and 5).

In one animal there was much pus in the sinus in spite of a large opening into the nose.

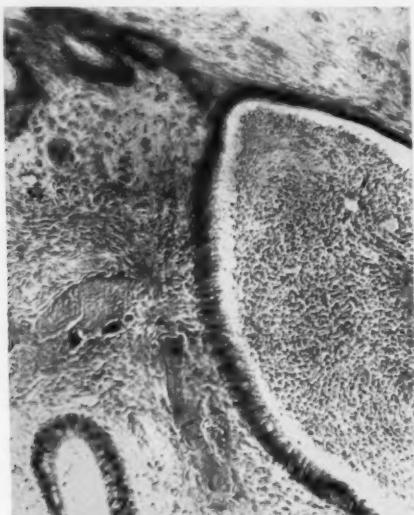


Fig. 6A. High magnification (135x) of the encircled area in Fig. 4. Cysts are seen lined with columnar epithelium in which are numerous goblet cells. The cyst is filled with mucus and pus. Osteoclasts (O C) are seen destroying old bone in the fibrous tissue.



Fig. 6B. Higher magnification (45x) of area enclosed in square in Fig. 5. Mucus-filled cysts lined with columnar epithelium are seen. These contain pus. New bone is seen at the edge of the slide.

The microscopic changes were similar in all the animals examined, no great differences being noted in animals sacrificed after 10, 20 or 60 days. On the side from which the "leaf" has been removed and the nasofrontal duct curetted the sinus is filled with young granulation tissue. There is marked new bone formation in the region of the ostium and throughout the sinus. Scattered in the mass of granulations are seen small cysts lined with epithelium and filled with mucus and pus (see Figs. 6A and 6B).

It appears from these experiments that in dogs, when the frontal ostium and nasofrontal duct are enlarged: 1. Infection results in spite of aseptic precautions. 2. The cavity of the sinus becomes filled with granulations and fibrous tissue containing mucus-filled cysts, many of which contain pus. 3. There is marked new bone formation in the region of the curetted ostium which blocks communication with the nose and adjacent sinuses. 4. In spite of the patency of the newly formed ostium (one animal) the sinus still contained pus, indicating that gravity plays no major rôle in the drainage from the frontal sinus.

GROUP II. RADICAL REMOVAL OF THE MEMBRANE OF THE  
FRONTAL SINUS WITH ENLARGEMENT OF  
THE OSTIUM AND NASOFRONTAL DUCT.

The entire lining mucosa of five frontal sinuses was removed, as was the "leaf." The nasofrontal duct and ostium were enlarged by curetting and the nose entered through the anterior ethmoid cells. An opening perhaps 0.5 to 0.75 cm. was thus obtained (see Fig. 1). The animals were sacrificed on the fifth, twentieth, thirty-seventh, fifty-sixth and seventy-seventh day following operation. The heads were frozen and coronal sections made. On the fifth day the sinuses contained a little blood clot, no other change being noticed grossly. Microscopic sections show no remaining epithelium in the sinus. There is some blood clot in the lower part.

In the 20-day animal the sinus was seen grossly to be free of pus or clot; it was, however, considerably diminished in size. The operatively enlarged ostium had healed by scarring and measured 0.25 cm. in diameter.



Fig. 7A. Photograph of serial section of a 20-day animal in Groups 2 and 3, viewed from behind. The right frontal ostium, "Leaf" and nasofrontal duct were destroyed and the mucosa removed from the sinus. The mucosa was removed from the left frontal sinus to within one-fourth inch from the "Leaf." The "Leaf" and ostium were not touched. Partial obliteration of the right frontal with fibrous tissue (F T) and new bone (N B) is seen. Pus is seen in the lateral part of the sinus. The mucosa in the left frontal can be seen. (E) ethmoid cell. (A G) agger nasi cell. (L) "Leaf" of left frontal.

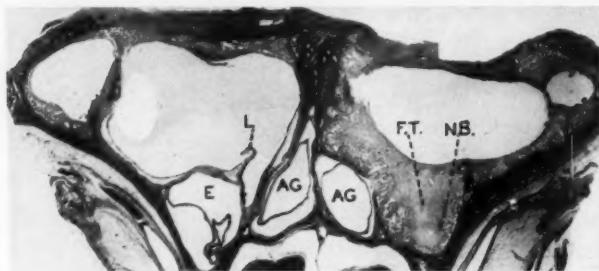


Fig. 7B. Twenty sections more anterior than Fig. 7A.

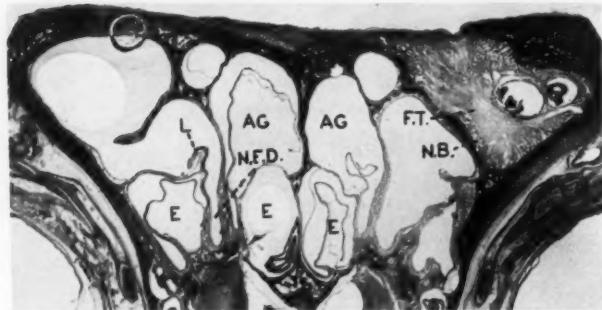


Fig. 7C. Seventy sections more anterior than Fig. 7B.

Microscopically, the frontal sinus is empty except at the most lateral part, where some pus is seen (see Fig. 7A). No epithelium lines the cavity except at the outer angle, where

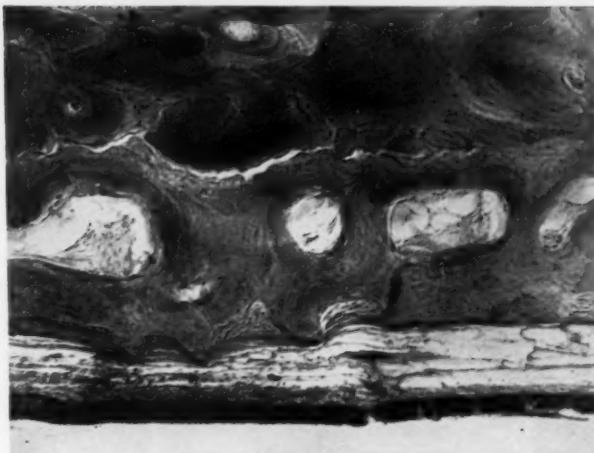


Fig. 8A. Higher magnification (135x) of area encircled in Fig. 7C in left frontal sinus, showing columnar ciliated epithelium and normal mucosa.



Fig. 8B. Higher magnification (50x) of area encircled in Fig. 7A in right frontal sinus. The epithelium at the right is columnar ciliated but at the left of the section the epithelium is absent and an exudate covers the fibrous tissue. Pus and mucus are seen in the sinus cavity.

apparently some mucosa was left behind at operation. There is a thin exudate adherent to the wall throughout. In the area previously occupied by the "leaf" and ostium there is young fibrous tissue and new bone formation (see Figs. 7A

and 7b). In the more anterior sections (see Fig. 7C), areas that appear to be cysts containing pus can, on serial section, be traced and identified as an anterior prolongation of the frontal sinus.

The findings both grossly and on microscopic examination were similar in the 37-, 56- and 77-day animals. Grossly, the cavity of the sinus was filled with granulations, fibrous tissue and pus.

In microscopic sections in two animals (56- and 77-day) a cavity is observed which appears not to communicate with the nose or ethmoid cells. It is surrounded by fibrous tissue



Fig. 9. Coronal section of a 77-day animal in Groups 2 and 3, view from behind. The left frontal ostium, duct and "Leaf" were removed with the lining mucosa. The cyst (CY) containing mucus and pus is seen and the rest of the sinus is filled with fibrous tissue and new bone (N B). The membrane was removed from the right frontal sinus but the "Leaf," ostium and nasofrontal duct were not disturbed. The sinus is seen to be empty, the "Leaf" (L) is in place and there is no new bone formation. (E) ethmoid cell. (A G) agger nasi cell.

and new bone and lined by columnar ciliated epithelium. The cavity contains mucus and pus (see Fig. 9).

It was not possible to determine in these experiments where the epithelium lining the cavity originated. It seems likely that it grows from the ethmoid cells that are opened at operation and from small portions of membrane that have been left in the frontal sinus at operation (see Fig. 8B).

A summary of the findings in this experiment shows that in dogs, following radical removal of the mucous membrane of the frontal sinus and enlargement of the ostium and naso-

frontal duct: 1. A blood clot accumulates in the cavity of the sinus. 2. Fibrous tissue and new bone grow into this clot and tend to obliterate the sinus, and in the fibrous tissue a cavity remains or forms which is lined with epithelium and contains pus. 3. The enlarged ostium and nasofrontal duct may heal by scarring and in time become completely occluded, so that the pus-containing epithelium-lined cavity does not communicate with the nose.

GROUP III. RADICAL REMOVAL OF THE MUCOSA OF THE FRONTAL SINUS TO WITHIN ONE-FOURTH INCH OF THE LEAF AND OSTIUM BUT WITHOUT INTERFERENCE WITH THE LEAF, OSTIUM OR NASOFRONTAL DUCT.

The same animals were used in Groups II and III, the opposite frontal sinus being treated in Group III to those described in Group II. The changes that occurred in 5, 20, 37, 56 and 77 days are described in this series. This affords a good comparison between the two operative procedures. In the 5-day animal no gross or microscopic difference is noted between Group II and Group III except that the "leaf" is intact. In the 20-day animal the sinus grossly is free from clot or pus, the cavity appears much larger than that of the opposite side (Group II), and the "leaf" is normal. Microscopically, the cavity of the sinus is lined with normal appearing epithelium throughout, except over a small area of the roof through which the sinus was entered.

In the 37-, 56- and 77-day animals grossly, the sinuses were clear and negative (see Figs. 7 and 9). This is in sharp contrast to the sinus described in Group II. Microscopically, the cavity is clear, the "leaf" and nasofrontal duct are well defined, and the cavity is lined throughout with columnar epithelium (see Fig. 8A).

It appears from these experiments that in the dog, removal of the mucosa lining the frontal sinus, when the "leaf" and nasofrontal ostium and duct are not touched, is followed in some 20 days by regeneration of the epithelium and mucosa and only minimal new bone formation. There is no apparent infection in spite of no aseptic precautions during surgery.

## DISCUSSION.

Conclusions as to what may happen in humans from the results of experimental work in dogs may be open to criticism. Such criticism has indeed been leveled at most experimental work in the field of otolaryngology. The anatomical and functional differences in the nose of dog and man may to some extent justify such criticism. Nevertheless, the regeneration, reaction to trauma, and inflammatory changes of the mucous membrane of the respiratory tract under similar experimental conditions have been shown to be approximately the same in all mammalian species. It seems justifiable, therefore, to postulate that under like circumstances, changes in the human are similar to those in the dog in respect to the sinus and nasal mucosa. In support of this contention are the findings of Knowlton and McGregor,<sup>6</sup> who demonstrated regeneration of the epithelium, after complete removal, in the antrum of a dog and similar regeneration in human antrums<sup>7</sup> following a Caldwell-Luc operation.

Hilding<sup>8</sup> reported complete obliteration of the frontal sinus in dogs following complete removal of the lining mucosa. He describes the sinus as filled with scar tissue; there were cysts within this scar tissue when small portions of the epithelium had been left behind. In some of his animals there was "partial restitution of the sinus, with regeneration of the epithelium."

Coates and Ersner,<sup>9</sup> in an experiment on a dog in which the lining mucosa of the frontal sinus was completely removed, found regeneration of the epithelium over a thickened mucosa and no obliteration of the sinus cavity. After repeated removal the sinus cavity was reduced in size by scar tissue.

The apparently paradoxical results of these experiments are possibly explained in the results reported here. In none of the reports quoted above was any mention made of the "Leaf," nor whether it or the ostium of the sinus was disturbed. The experiments reported here show that obliteration of the sinus depends on removal of the "leaf" and interference with the ostium.

It is stated above that the function of the "leaf" is not known. Hilding has suggested that possibly it governs in

some way the mucus flow in the sinus. This explanation seems credible. It is apparent, however, that the integrity of the ostium, "leaf" and frontal duct are essential for drainage from the sinus, and that gravity plays little, if any, rôle in the drainage from the frontal sinus.

If it is assumed that an analogy can reasonably be drawn between dog and man in regard to frontal sinus physiology, the results in Group I described above indicate that the enlargement of the nasofrontal duct and frontal ostium effected in the intranasal frontal operation, is doomed to failure. The normal mechanism of drainage from the sinus is destroyed in this procedure which is based on the faulty hypothesis of gravity drainage. Furthermore, the removal of mucous membrane and trauma to bone result in new bone formation and complete occlusion of the operatively formed ostium; the end-result being an infected sinus which does not communicate with the nose.

Brown<sup>10</sup> has recognized this fact, for he stated in discussion of the intranasal treatment of chronic frontal sinusitis, that any obstruction to drainage from the sinus, such as an enlarged anterior tip to the middle turbinate or infected adjacent ethmoid cells, should be removed; but "that the use of a rasp has not been found worthwhile, and on the contrary is probably responsible for postoperative stenosis of the nasofrontal passageway by stimulating new bone formation. The intranasal operation should endeavor merely to remove anatomical and pathological obstruction at the inferior aspect of the nasofrontal passageway."

The results in Group II in which the sinus mucosa was removed and the ostium and nasofrontal duct enlarged indicate why the classical radical frontal operation has proved very unsatisfactory in so many cases.<sup>11</sup> The patency of the newly formed ostium is not maintained, and the cavity of the sinus becomes filled with scar tissue in which there is cyst formation if any particle of epithelium has been left at operation. This epithelium is infected if the indications for the radical frontal operation have been present.

The patency of the nasofrontal duct has been maintained by skin grafting.<sup>12</sup> It is questionable, however, whether such

a procedure accomplishes anything other than a means for cannulization of the frontal sinus.

The findings in Group III of a clean sinus, completely relined with normal mucous membrane in so short a time as 20 days following radical removal, led to the hope that a similar operation, aimed at preservation of the frontal ostium and nasofrontal duct, might yield similar results in man. Three patients have been treated in this manner. The frontal sinus was entered through the floor and all the lining mucosa to within one-fourth of an inch from the ostium removed. The frontal ostium and nasofrontal duct were not touched, except that a fine, blunt silver probe was passed from the sinus into the nose to be sure that the duct was patent. A small rubber drain was left in the inner angle of the wound for 24 hours and then removed and the wound allowed to close. The frontal sinus was washed by passing a cannula through the nasofrontal passageway two or three times following the operation. The results have been gratifying.

#### CASE REPORTS.

*Case 1:* F. A., 46, colored female, was seen in the out-patient department in August, 1940, with bilateral maxillary sinusitis and right frontal sinusitis. X-rays of the sinuses showed clouding of both antrums and of the right frontal. In the right frontal sinus there was a shadow which was diagnosed by the Roentgenologists as an osteoma; it crossed the midline and abutted on the left sinus. Washing of both antra produced pus, and the right frontal sinus was washed, by means of a cannula in the nasofrontal duct, with purulent return. Antrum windows were made and in September, 1940, an external frontal operation was performed. The floor of the right frontal sinus was removed, and thickened membrane and pus were seen in the sinus. Owing to the extent of the sinus, however, part of the anterior table of the frontal above the supraorbital ridge was removed and the membrane thoroughly cleaned from the sinus down to a point a quarter of an inch from the ostium. The shadow which had been diagnosed as an osteoma was found to be a cell filled with mucopus which extended through the septum into the left frontal sinus. The cell was thoroughly cleaned. The left frontal sinus was opened and inspected and found to be normal; the membrane, therefore, was not removed. There was no interference with the ostium or nasofrontal duct on either side. A drain was left in the angle of the wound, and this was removed on the following day. The patient had an uneventful postoperative course and was completely free from nasal symptoms until September, 1941, when she took a cold. She came back to the clinic in December, 1941, with edema over the right side of the forehead, extending to the hairline and just to the left of the midline. X-rays taken at this time showed no apparent osteomyelitis. The right frontal sinus was washed through the nasofrontal duct with no difficulty, and much pus was obtained. The edema subsided to some extent, but finally an abscess pointed at the inner end of the eyebrow. This was incised and a drain inserted. The fistula remained open in spite of washing and free drainage. In March, 1942, the right frontal sinus was reopened and

was found to contain a large amount of granulation tissue with a pocket of pus at the outer angle of the sinus. These granulations were removed, and the anterior ethmoid cells were entered from the frontal, the wound being closed completely. There has been no further trouble to date.

In this case the large extent of the frontal sinus and infection of the anterior ethmoids, which were not dealt with at the first operation, appear to have been responsible for the reinfection of the frontal sinus and the necessity for a second operation.

*Case 2:* L. D., 28, white female, was seen first in April, 1941, with complaint of persistent left frontal headaches. Examination revealed pus in both sides of the nose and middle meatuses. X-rays showed clouding of both antra and of both frontal sinuses. The patient was treated by lavage of the antra and in May, 1941, a Caldwell-Luc operation was performed on both sides. X-rays taken some weeks after this operation showed clouding of the left frontal sinus and a clear right frontal sinus. The left frontal headaches persisted. The left frontal sinus could be entered without difficulty through the nasofrontal duct and repeated lavage produced pus but did not affect the headaches. In November, 1941, an external operation was done on the left side; the sinus was entered through the floor and all the membrane to within a quarter of an inch from the ostium was removed. One rubber drain was left in the inner angle of the wound for 24 hours and thereafter the wound was allowed to close. The patient has had no further pain and the left frontal sinus has been washed on two or three occasions with clear returns obtained at each washing. She was last seen in June, 1942, with no complaint.

*Case 3:* G. V., 24, white male, was seen on consultation because a search for foci of infection had been requested by the medical service. The patient had a subacute glomerular nephritis with marked edema and ascites. Examination showed pus in both middle meatuses and X-rays revealed clouding of both antra and of the left frontal sinus. A Caldwell-Luc operation was done on both sides. In March, 1942, a left frontal sinus operation was performed. The sinus was entered through the floor and thickened membrane and pus were found. The membrane was removed to within a quarter of an inch of the frontal ostium, and at the outer angle of the sinus the frontal was found to communicate with the supraorbital ethmoid cell. This cell also had thickened membrane and pus which was removed and an opening made into the nose posterior to the nasofrontal duct. The frontal ostium and the nasofrontal duct were not enlarged. A drain was left at the inner angle of the incision for 24 hours and removed. Since then the frontal sinus has been washed through the nasofrontal duct with clear returns. It is interesting that this patient's edema and ascites disappeared following the frontal surgery. The patient was last seen Dec. 8, 1942, at which time X-rays of the frontal sinus showed some clouding of the left, but washing was negative. The nose appeared normal and he had no complaints.

In all three cases care was taken not to interfere with the frontal ostium or the nasofrontal duct, and in each case it has been possible to pass a cannula into the frontal sinus without difficulty.

It would be an error to arrive at too definite conclusions from results in only three cases. It is suggested, however, that, in cases of chronic frontal sinusitis, in which obliteration of the sinus is deemed unnecessary, the modification of

the Lynch operation, described above, may be employed with success; the advantage being: 1. shortened convalescence; 2. a patent nasofrontal duct and ostium; and 3. the probable return of the sinus to a normal physiologic state.

These experiments confirm the wisdom of Mosher's advice, *viz.*, to preserve the virginity of the nasofrontal duct.

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## LOCAL SULFONAMIDE THERAPY IN OTOLARYNGOLOGY.\*

DR. A. C. FURSTENBERG, Ann Arbor, Mich.

Since the advent of chemotherapy and proof of its efficacy in systemic infections, much interest has developed in the local use of the sulfonamide drugs in traumatic and surgical wounds. They have been used in infected wounds, in others in which a bacterial activity was anticipated and in those that were clean from the start and gave promise of remaining aseptic. A variety of reports have appeared in the literature, varying from enthusiastic support of local chemotherapy to publications of lesser praise; nevertheless, the weight of evidence is in favor of its continued application and further researches in this field. A review of 30 publications on this subject which have appeared since 1939 reveals some astonishing differences of opinion in regard to the minutia of local sulfonamide therapy, yet the general trend is disposed to a recommendation of these agents in wounds which harbor infection. The consensus of opinion invariably leads to the conviction in most instances that sulfonamide therapy has a distinct place in the field of surgery and is worthy of trial whenever indicated and practicable.

When chemotherapy was first instituted in our clinic some six years ago we commenced its local use in mastoid wounds after mastoidectomy for acute infection. Both sulfanilamide and sulfathiazole were employed, depending upon the type of organism found in the tissues. As is customary with the introduction of most new forms of therapy, our enthusiasm ran high. We were convinced that it promptly dispelled infection of great virulence, that it rendered the patient immune to septic reactions and that bacterial-laden tissues thus treated would promptly heal in a phenomenal manner. In a measure, some of these early observations have been substantiated but as our experience grew, it became obvious that this form of therapy did not produce the miracles which we

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had fancied from the start. When the phase of wishful thinking and hopeful expectancy had passed and studies instituted with a clarity of objective and a precision of action, our verve for local sulfanilamide therapy was reduced to little more than a modest belief that it was a therapeutic adjunct to a surgical procedure well done.

To be specific, we have employed chemotherapy locally after every mastoid operation, simple and radical, which has been performed in the clinic during the past five years. After the so-called simple or complete mastoidectomy, the wound is filled with sulfanilamide powder or crystals and the upper two-thirds of the skin incision closed for primary union. In the lower extremity of the wound we place a small wick, which is employed merely for the purpose of separating the wound margins in order that dependent drainage may be maintained. The dressings are not disturbed for five days. At this time the wick at the inferior extremity of the wound is loosened and withdrawn slightly but no attempt is made at any time to repack beyond the depths of the skin thickness. In other words, we sedulously avoid the introduction of a pack, a drainage tube or an instrument into the mastoid cavity for reasons which have become obvious to us through experimental studies; namely, that such a practice almost invariably leads to the introduction into the mastoid wound of secondary bacterial invaders. How frequently we have observed a pure culture of organism taken from the mastoid cavity at the time of operation only to find a mixed infection at a later date! These organisms, such as the *bacillus coli*, the *bacillus pyocyanus* and sometimes the *staphylococcus* are "hangers-on"; not responsible primarily for the infection which we are endeavoring to eradicate but, nevertheless, intruders which frustrate repair and prolong the period of convalescence.

In a series of cases we introduced a sterile glass tube under strict aseptic precautions into the dependent portion of the mastoid wound, and with a platinum loop passed through the tube into the mastoid cavity we obtained serial cultures from patients in whom chemotherapy locally had been employed. It was demonstrated repeatedly that the wound became sterile in five to 10 days after operation and remained as such throughout the period of healing. Moreover, on each succeed-

ing postoperative day fewer colonies of organisms were found until the wound became germ-free. If, on the other hand, we used a pack within the mastoid cavity, withdrew and inserted it on the customary third to fifth postoperative day, we would invariably discover at the subsequent dressing that the wound contained a mixed flora of bacteria. This observation was made so frequently and so consistently that it could lead to but one logical conclusion; namely, that contamination of the mastoid cavity by secondary bacterial invaders was chargeable to our time-honored method of dressing the mastoid. It is my personal conviction that much of the pus that pours out of a mastoid cavity after an operation that has been well done is due to the error of inserting packs into a mastoid wound by the overzealous doctor in charge of the patient's postoperative care. Shall we take a lesson, therefore, from the orthopedic surgeon, who has demonstrated beyond peradventure of doubt that compound fractures treated by careful debridement, the local use of sulfanilamide and the closure and sealing of wounds heal more rapidly and more kindly than those subjected to any other form of management? While we must not permit infection to become trapped under pressure within a temporal bone because of the vital adjacent cerebral coverings, nevertheless, I am convinced that if mastoid operations were always well done, the wounds left partly open and the head enclosed in a plaster cast, to keep the doctor out of the field, healing would be more satisfactory and convalescence more rapid in the average patient!

All this is predicated on the assumption that a thorough and complete mastoid operation has been performed. In temporal bone infections there is no therapeutic compromise for a surgical procedure carefully and adequately executed. No quantity of sulfanilamide and no amount of meticulous post-operative care will supplant the complete eradication of diseased bone and drainage of all infected cells when the mastoid process is the seat of an inflammatory disease. And herein lies the danger that is invariably lurking where trust is placed in a chemical agent employed to augment the efficacy of an operative procedure; namely, the danger of slovenly surgical habits when misplaced confidence is held in unworthy therapeutic adjuncts.

No matter how carefully and skillfully surgical dressings

are applied — rubber gloves, sterile gown, skin preparations, etc. — contamination is almost invariably the rule when mastoid packing is removed and the cavity repacked. The experience of time seems to justify the contention that these practices are unnecessary and that if the dependent portion of the mastoid wound is left open, there need be no apprehension concerning satisfactory and adequate repair. It is now axiomatic in our clinic to dress a mastoid wound as infrequently as possible and to remain outside the cavity after the patient has left the operating room. This is an immutable law which is violated only in cases of lateral sinus thrombosis or when the patient fails to recover satisfactorily and a review of the mastoid process or petrous pyramid seems indicated. It is a matter of verity that the patient who does not become asymptomatic and develops a dry or nearly a dry middle ear and mastoid cavity within 10 days after the mastoid operation demands a surgical review of his temporal bone. No therapeutic agent will serve the purpose of a well directed secondary surgical effort when such a situation arises.

Our postoperative management of the radical mastoid cavity has been similar to that above described. The wound has been filled completely with sulfanilamide powder and a pack used only in the external auditory meatus. This serves the purpose of controlling hemorrhage and of holding the skin flap derived from the posterior canal wall back into position within the mastoid cavity. The middle ear and external auditory canal are likewise filled with the chemical agent.

It is extremely difficult to evaluate accurately and scientifically our results with this form of therapy because of our inability to run a group of controls. Any experiment of unassailable scientific accuracy must necessarily call for a series of cases with identical factors of age, resistance, tissue immunity, anatomical development, bacterial virulence, etc., in which surgical procedures with chemotherapy are employed in one-half of the group and operation without local treatment used in the remaining half. Obviously, ideal situations of this character do not exist in surgical practice; nevertheless, over a period of six years, our observations lead to the conviction that this form of therapy has a definite place in the field of otology. There is every indication that

wounds tend to heal more kindly, more rapidly and with less discomfort to the patient when the sulfonamides are used locally than when they are not employed. Stitch abscesses are rarely observed, inflammatory reactions such as redness and swelling are comparatively uncommon, and a perichondritis has not occurred since local chemotherapy became routine in our clinic.

We have had insufficient experience with the sulfonamides other than sulfanilamide to express an opinion in regard to the value of the other preparations. Sulfathiazole has been used extensively but has been relegated out of our therapeutic armamentarium because of its insolubility. The general surgeons learned early in their experience that it often produced foreign body reactions in the abdomen, and we, too, have had some annoying experiences in digging it out of mastoid cavities in which it remained in a hardened mass until mechanically removed. The combination of sulfanilamide and sulfathiazole powder now furnished by some of the pharmaceutical houses is less undesirable; nevertheless, it, too, has reacted similarly in some instances because of its insoluble sulfathiazole component.

There is clinical evidence supported by pathological studies that a concentrated form of local sulfonamide treatment tends to retard the progress of repair in some cases. It would seem paradoxical to say that the healing period of a mastoid wound was shortened and at the same time admit that the chemical agent showed a tendency to delay repair. The point to be emphasized, however, is that the total period of recovery from the day of the mastoid operation to the complete closure of the wound is appreciably shortened in spite of the recognized fact that the sulfonamides may delay the healing processes. The rate of repair when favored by the absence of infection exceeds the delay induced by local sulfonamide therapy and gives a net result greater than that which would be obtained in an untreated septic wound. In most of our cases it was particularly noticeable that when local chemotherapy was used postoperative dressings were simplified, tissue repair adequate, and comparatively rapid, with a conspicuous absence of wound irritation and discomfort to the patient during the first few days of postoperative convalescence.

If the supply of sulfanilamide powder within the wound becomes exhausted as the result of dissolution it is important to replenish it by insufflation. The skin margins of the lower extremity of the wound are separated with a nasal speculum and powder blown directly into the cavity. One might question the desirability of keeping the mastoid cavity filled with the powder on account of its tendency in a concentrated form to impede the processes of repair; however, it does not seem to be necessary to use the agent in such proportions when the infection appears to be well under control. One can demonstrate in microscopical studies of granulation tissue taken from the skin margins and from within the mastoid cavity, that poor vascularization is in evidence when a prolonged concentration of the drug is employed. Obviously a pathological reaction of this character is to be avoided.

We have gained the impression in a number of instances that this effect of retarded healing which we revile during the period of recovery from an operation for acute mastoiditis is to be praised in the days which follow the radical mastoidectomy. There are times when our most diligent efforts to control the growth of exuberant granulation tissue within the radical mastoid cavity have been discouraging and futile. This experience has been much less frequent since the instillation of local chemotherapy, for the reason that the sulfanilamide powder has apparently accomplished precisely the desired objective. It has obviously discouraged the growth of granulation tissue and thereby given the wound an opportunity to epithelialize with the preservation of a well formed tissue within the tympanum. If the latter is true we may find in this form of therapy a measure of inestimable value in securing the maximum of auditory function after the radical mastoid operation.

While our experience with the local use of sulfonamide preparations has been limited chiefly to the temporal bones, we have used it extensively for other purposes. Its value as a dusting powder in the preparation of a bed for a skin graft cannot be overestimated. It seems to have achieved phenomenal results in many of our cases where skin grafts were used in the middle ear and mastoid cavity after the radical mastoidectomy. In the frontal sinuses, ethmoids and maxillary antra, local chemotherapy seems to have given us some grati-

fying results. It has been particularly noticeable that our patients have not evidenced large, painful swellings over the face and extensive edema of the eyelids after radical operations upon the nasal accessory sinuses when sulfanilamide was employed; moreover, the absence of these troublesome and grotesque reactions has been associated with much less discomfort on the part of the patient than was routinely observed before the advent of this form of therapy. Dusted into the larynx after the laryngofissure, it seems to have given some evidence of merit. Tucker has warned against its use in concentrated form within the larynx, however, on account of the possible delay of tissue repair and consequent predisposition to the development of a perichondritis. When used in the wound after a laryngectomy or a tracheotomy, its benefits can hardly be questioned. And finally I should feel a deep sense of insecurity were I to be deprived of sulfonamide powder for the wound of a cervical mediastinotomy or the second stage procedure for the relief of a cervical esophageal diverticulum. In the former, when employed to drain a mediastinitis secondary to a traumatic perforation of the esophagus or a bacterial invasion from the cervical region, local sulfanilamide therapy has in my opinion been a life-saving aid of inestimable value.

Perhaps I have overstepped the bounds of academic propriety exhorting the virtues of sulfanilamide for the many purposes above-mentioned; nevertheless, it is generally agreed by those who have had experience in the treatment of septic wounds that its value is above reproach. We cannot fail to pay tribute to the work of Dr. N. K. Jensen and Dr. M. C. Nelson, who have given meticulous attention to this study and deduced from their careful clinical observations and skillful experimentation facts which clearly concede the meritorious effects of the sulfonamides when used locally in septic wounds. Their conclusions demand our respect. On the other hand, lest we be carried away by unwarranted enthusiasm and influenced to the extent of misplaced confidence, it may be well to temper our ardor somewhat by referring to recent reports from the centers designated by the government for the experimental study of the local effects of the sulfonamide preparations. In the light of the experiences of those who have published favorably on this subject during the past five years, the reports are indeed disquieting. It has been stated

by these agencies working under Federal subsidies that septic wounds treated with the sulfonamide preparations have not healed more rapidly or satisfactorily than the controls. In connection with these reports one might properly raise many questions, as, for example, the size and depth of the wounds treated, their vascularity, anatomical position, and the virulence of the infecting organisms; moreover, to what extent was repair favored by careful and meticulous debridement; all are factors which make it exceedingly difficult to furnish reliable controls in clinical experiments of this character.

I must emphasize that I should strongly oppose the use of the sulfonamides locally in clean wounds and where subsequent infection is not anticipated. Its tendency to produce hemorrhage and its known potency for delayed healing are factors of sufficient importance to contraindicate its employment in aseptic wounds. It is a hydroscopic salt and as such must necessarily cause tissue reactions which are not altogether ideal for the wound that does not require a toxic chemical agent for the fight against infection.

#### CONCLUSIONS.

1. Sulfanilamide when used locally in septic wounds tends to shorten the period of convalescence, prevent troublesome local reactions and allay discomfort.
2. In a concentrated form and prolonged application it evidences a deleterious effect upon the processes of repair.
3. It is unnecessary and undesirable to use it in a clean wound.
4. Finally, it must be stated with emphasis that it is no substitute for a surgical procedure adequately performed. There is no compromise for an operation carefully and skillfully executed to the extent that its fullest objectives are reached. Confidence in local chemotherapy is justified only when it is employed as an adjunct to an operation which is performed with credit to the surgeon and safety to the patient.

## PAPILLOMA OF THE LARYNX. A REPORT OF TWO UNUSUAL CASES.\*†

DR. LAWRENCE R. BOIES, Minneapolis.

Papilloma of the larynx is not a rare disease in the experience of the average laryngologist. It is rather common in the busy dispensary dealing with throat cases.

Two cases seem to be of sufficient interest to warrant reporting, inasmuch as certain developments in each case are unusual; moreover, the course of the papillomata stimulates renewed speculation over the etiology and behavior of this disease.

*Case 1*; K. B. was born in 1898. At the age of 5 years he became hoarse. A doctor was consulted in the small north woods town in Minnesota in which the boy resided, and the parents were advised that the cause of the hoarseness was tuberculosis. This hoarseness persisted without any other signs of illness for seven years, until he began to have gradual difficulty in breathing and lost weight. When the respiratory difficulty became acute he was sent to the University Hospital in Minneapolis. This was in 1910. The admitting notation describes him as "very short of breath and emaciated." An emergency tracheotomy was done by the genera surgical staff. The patient apparently stopped breathing during the operation and was revived with difficulty. One month later a laryngotomy was performed by the same general surgeons. The operative record contains this notation: "with the finger and dull curette the cauliflower-like growth was entirely removed from the true vocal cords. Hemorrhage was controlled by pressure and hot sponges." The tracheotomy tube was removed several weeks later and the boy was sent home.

There is no record of any follow-up for the next 16 years.

In 1926, at the age of 28 years, he came back to the University Hospital seeking an improvement in his voice, which had been continuously hoarse since the operation in 1910. A laryngologist treated him at this time. On the operative record there was this notation: "under ether anesthesia direct laryngoscopy was employed to remove a papilloma of the left vocal cord, about 1cm x 6 mm. x 6 mm. in size; the base was fulgurated." For some reason not explained by any details in the record, the discharge note includes this statement: "partial removal of papilloma of the larynx." Again, there was no record of a follow-up.

In March of 1938 this patient returned to the Out-Patient Department of the University Hospital, again seeking relief of his hoarseness and what he described as a "tickling in the throat" and "cough." There had been no satisfactory recovery of his voice since his operation here 12 years earlier.

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Examination with the laryngeal mirror revealed an approximation of his ventricular bands on phonation, with a cyst-like protuberance of the right ventricular band. As he inspired and the cords abducted, a papillomatous mass could be seen attached to the anterior half of the left vocal cord. We decided that the patient had, in addition to his papilloma, two other lesions—a *dysphonia plicae ventricularis* and an *internal laryngocoele* on the right side.

After preliminary tracheotomy, a laryngofissure was performed under local anesthesia supplemented with avertin. A papillomatous-like mass was removed from its rather broad attachment to the anterior one-half of the left vocal cord; also a small papilloma attached to the anterior of the right vocal cord. The base of each was cauterized with diathermy. Then the cyst-like protuberance of the right ventricular band was investigated. A blunt probe was passed through the ventricle of the larynx to project this swelling medialward and it was evident that we were dealing with a dilatation of the ventricle of the larynx on the right. The protruding portion was clipped off, allowing the edges to approximate. The left ventricle was also explored and it was possible to project the ventricular band medialward on this side. A piece of this protruding portion was also clipped away. The edge readily approximated. The larynx was then closed. Convalescence was uneventful.

At the end of three weeks, however, a fullness of the right ventricular band had again developed. We decided to give this additional treatment. Using suspension laryngoscopy, with the patient under gas anesthesia administered through the tracheotomy tube, the fold of the bulge in the right ventricular band was grasped, clipped off, and then the inside was cauterized with surgical diathermy.

From that point, healing was uneventful. The patient developed a good voice, though a slight amount of hoarseness persisted. The ventricular bands still approximated on phonation. Nearly five years have passed since this treatment. I have seen the patient at intervals and as recently as December of 1942. There has been no recurrence of the papilloma or the laryngocoele. He is now employed in a defense plant.

Fig. 1A represents a photomicrograph of a section of the papilloma made in 1926; Fig. 1B shows a section of the papilloma made in 1938.

Fig. 2A shows a section of the epithelial lining of the ventricle, and Fig. 2B shows the more dilated part of the laryngocoele.

This case is unusual for two reasons: 1. We have evidence that a papilloma was present in this man's larynx for approximately 35 years. It apparently began when he was about 5 years of age, increased so as to interfere seriously with respiration during his early adolescence, and a portion of the site of the original papilloma continued to be the site of papillomatous change through a number of years of adult life. 2. The mechanics of laryngeal function with a tumor mass keeping the vocal cords apart apparently resulted in his *dysphonia plicae ventricularis* and in the production of his laryngocoele.

Dysphonia plicae ventricularis was first described by the Jacksons<sup>1</sup> in 1935. They defined this condition as "phonation with the ventricular bands instead of the vocal cords. It may

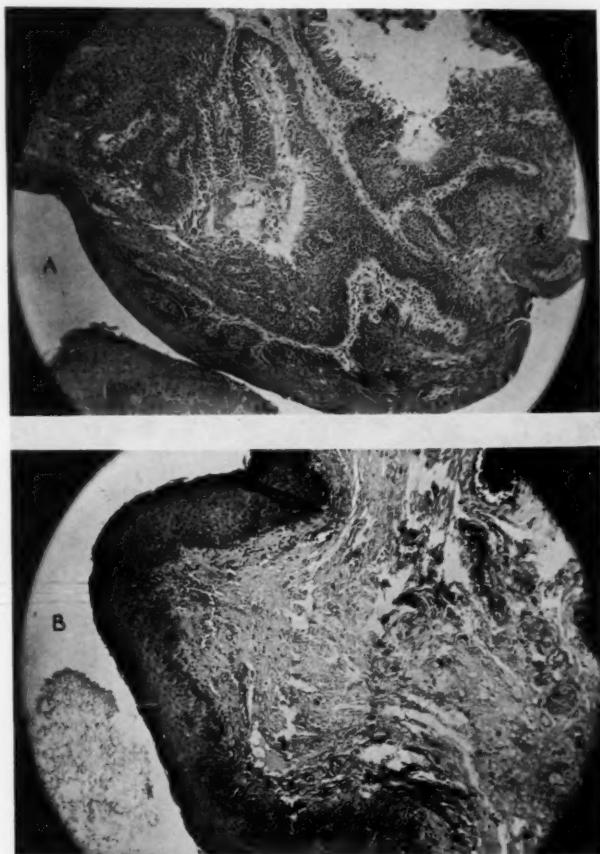


Fig. 1. Sections of the papillomatous tissue removed in (A) 1926 and (B) 1938 (magnification 100x).

The architecture of the tissue in (A) would suggest the "villous" type of papilloma, while that in (B) suggests the "simple" type.

Clinically, both were of the villous type. The difference in appearance can be accounted for by the difference in portions sectioned.

be a vicarious dysfunction with a pathologic basis or a physiologic compensation for lost or impaired vocal cords. It may be congenital or acquired; temporary or permanent."

In reference to the etiology and pathology, they state: "In many instances the hyperactivity has started when the voice was strongly forced during the temporary impairment of the vocal cords in acute laryngitis. . . . This vicarious functioning

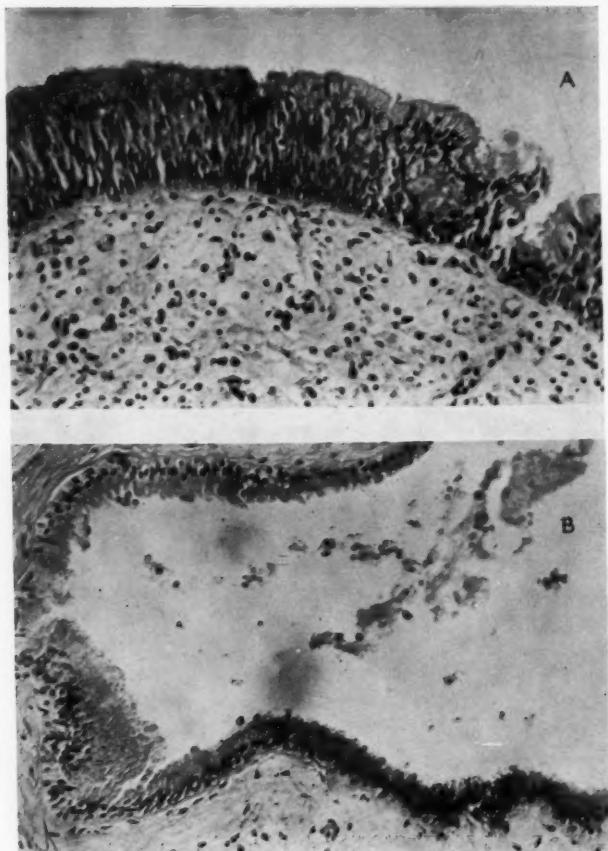


Fig. 2. Photomicrographs of (A) the wall of the ventricle of the larynx, and (B) the more dilated wall of the laryngocoele.

is seen after ventriculocordectomy and is, in these cases, the result most desired. It obviates waste of air, functions as a valve, assists in expectoration and produces a good voice. . . . Tumors mechanically propping the cords apart may cause

the ventricular bands to take on vicariously the function of phonation."

It is this information which is the basis for my belief that the dysphonia plica ventricularis in this case was the result of the mechanical propping apart of the cords over a considerable period of time.

Planographic studies have been the means of demonstrating the positions of the vocal cords and ventricular bands in various acts of laryngeal function. Fig. 3A shows the posi-



Fig. 3. Planographic studies demonstrate the normal position of the vocal cords and ventricular bands in various acts of laryngeal function.

(A) Normal phonation. The cords (a) approximate while the ventricular bands are apart (b). This is exaggerated on inspiratory phonation (B).

(C) when one strains, as in the act of lifting, coughing, etc., both the true cords and false cords are tightly pressed together and the intratracheal pressure has widened the trachea.

tion of the vocal cords in normal phonation. The cords approximate while the ventricular bands are apart. This is exaggerated on inspiratory phonation (see Fig. 3B). When one strains, as in acts of lifting, coughing, etc., both the true cords and the false cords are tightly pressed together and the intratracheal pressure has widened the trachea (see Fig. 3C).

I do not have planographs of the larynx in this case for 1938, inasmuch as we were not taking them at that time; I have, however, planographs recently made of his larynx. Fig. 4 shows this larynx in ordinary phonation. Both the vocal cords and the ventricular bands are approximated as one would expect when a dysphonia plicae ventricularis is present. I have for comparison a planograph of another

patient's larynx, who has a dysphonia plicae ventricularis (see Fig. 5). This is a case of moderate hoarseness of years' standing in a young woman who has been seen by laryngologists in several cities, all of whom have made the diagnosis. Note the contact position of both the vocal cords and ventricular bands in ordinary phonation.

The subject of laryngocoele ventricularis has been recently reviewed by Lindsay<sup>2</sup> in excellent detail. He has demonstrated



Fig. 4.

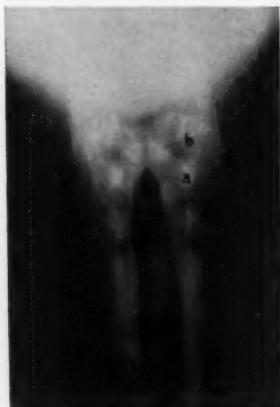


Fig. 5.

Fig. 4. Planograph of K. B.'s larynx shows that both the vocal cords and ventricular bands approximate on ordinary phonation. The fact that his ventricular bands approximate in this phonatory function is because of the persistence of his **dysphonia plicae ventricularis**.

Fig. 5. Planograph of another larynx showing both the vocal cords and ventricular bands approximating in ordinary phonation. This patient has had a dysphonia plicae ventricularis for many years and has a definite hoarseness.

by planographic study that an increased intraglottic pressure in acts of laryngeal function should be considered to be an important factor in the development of a laryngocoele.

It would seem reasonable to believe that prolonged action of the ventricular bands in vocal function, in addition to its usual valve-like action in closing during acts of strain, together with a tumor mass being present to prop the vocal cords apart, would allow considerable pressure transmitted to the ventricles. *In this case one has all the evidence it is probably possible to obtain, that increased intraglottic pressure is a factor in the production of a laryngocoele.*

*Case 2.* My second case, P. S., is a man 53 years of age, who was first seen in March, 1941. For one year he had experienced a bulging of the right side of his neck when he would exert himself in lifting, coughing, etc. He had been hoarse for eight months. He also complained of a dry



Fig. 6. P. S. developed a bulge in his neck when he would close his glottis on exertion, as in lifting, coughing, etc. Later he became hoarse. A papilloma was found on the posterior wall of the trachea, about 3 cm. below the level of the cords (a). It had eroded some of the tracheal rings, allowing the trachea to herniate when the intratracheal pressure was increased. Another papilloma was found on the undersurface of the left vocal cord. The sequence of the development of his symptoms suggests that the papilloma of the cord was an implant from the one in the trachea.

cough, shortness of breath on exertion, so that he preferred to have his shirt collar unbuttoned most of the time. At times he had experienced a pain running out to his right shoulder.

Examination of the larynx with the laryngeal mirror revealed a papillomatous mass projecting from the lower surface of the left vocal cord

and another similar tumor could be seen projecting below from the posterior wall of the trachea, about 3 to 4 cm. below the level of the glottis. With the glottis closed and the intratracheal pressure increased by straining, he could produce a bulge on the right side of his neck beneath the lower half of the sternocleidomastoid muscle. Fig. 6 shows a lateral view of the larynx and upper portion of the trachea. The papillomatous mass can be seen attached to the posterior tracheal wall. The erosion of the tracheal rings and the tendency of the trachea to herniate can be seen.

These tumor masses were removed through the direct laryngoscope under local anesthesia. A report from the patient, by letter, in December, 1942, indicated that he has no hoarseness but is still bothered by his other symptoms. I am omitting further details of this case, inasmuch as it has been reported under the title of "Tracheal Ectasia" by Dr. Robert E. Priest,<sup>3</sup> of our department.

This case is unusual because of the fact that the history indicates that a tracheal papilloma occurred first and then a similar tumor developed on a vocal cord above. The enlargement of the neck was first experienced four months before the hoarseness occurred. This suggests the probability that the vocal cord tumor was an implantation. We know that implantations are not uncommon in the laryngeal papillomata of children. I had never previously observed it in the adult.

The unusual complications of the papilloma in each of these two cases are subjects in themselves. It would be almost an anticlimax to discuss papilloma of the larynx at this point; however, that is one of my purposes in reporting these cases. When I encountered them, my curiosity was stimulated again over the cause and course of this disease.

The important knowledge regarding papilloma of the larynx can be summarized from three considerations:

First, there is some evidence that these growths are caused by a virus infection. Ullman,<sup>4</sup> in 1923, reported two positive inoculatory results in six attempts with a bacteria-free filtrate. He also inoculated the vaginal mucous membrane of a dog with laryngeal papilloma. An emulsion of some papillomatous tissue removed from the larynx of a child was used.

It has been my clinical impression that the rapid appearance of papillomata in the trachea of a small child after scalping off multiple laryngeal growths was probably the result of expressing secretion from these growths in my efforts at the removal.

Implantation of papillomata on a mucous surface separate from a primary site is not uncommon. It occurs not infrequently in the papillomata of children.

Second, though one cannot distinguish histologically the papillomata of children from those occurring in adult life, we know that their clinical behavior is different. There is some evidence that endocrine factors affect the course of childhood papillomata. Broyles<sup>5</sup> has recently reported observations on the topical application of estrogenic substance combined with surgical removal. He suggests that the application of the estrogenic substance to the laryngeal mucosa changes the membrane to the adult type and gives adult characteristics to pre-existing papillomas so that when removed there is less tendency to recurrence. This is in line with the clinical fact that childhood papillomata tend not to recur after adolescence. Jackson<sup>6</sup> states: "in children they usually cease spontaneously after a few years."

The third consideration raises the question, Can a papilloma "turn into cancer"?

There has been a tendency to consider a papilloma as a pre-cancerous growth.

There is evidence that the development of a carcinoma at the site of a benign papilloma in an adult is rare, but that it does occur. Jackson<sup>7</sup> records 205 cases of papilloma of the larynx in adults in which cancer has developed at the same site in six cases (3 per cent). He stated, however: "there is no evidence to show that removal of the benign growths had ever had any influence in the malignant developments."

Ullmann made three attempts to transfer a solitary papilloma of an adult to healthy skin but without success. He expressed the opinion (in agreement with Virchow and Chiari) that the growths appearing singly in the larynx of adults and diagnosed as papilloma are not the same as the papillomata which appear in the larynx in quantity. These single growths in adults were referred to by Virchow as *Pachydermia Verrucosa* or *Circumscripta* and were considered to be analogous to the dermatological conditions of *Verruca Senilis* and *Verruca Seborrheica*. The tendency of these lesions to undergo malignant change is not surprising.

I have observed that there may be a lack of critical distinction both on the part of the clinician and the pathologist in diagnosing with exactness the simple growths of the adult

cords. Portions from the biopsied material of a papilloma, fibroma or pachydermia may bear a close resemblance. This means that it is important to consider the clinical picture as well as the histopathology.

The two cases just reviewed have in their development and course several aspects which seem to support the present contentions relative to laryngeal papillomata. In the first case, the beginning of the papillomata at the age of five and their spread over both cords, as found when operated at the age of 12, suggest an origin in an infection. There was apparently a sudden increase in early adolescence suggestive of an endocrine factor in this increased growth. The fact that the patient did not recover a good voice after the first removal indicated an incomplete removal, but apparently there was not a marked recurrence. The second removal in 1926 also seems to have been incomplete. For the next 12 years there was relatively little production of tumor. Probably some of the papillomatous tissue was in this larynx for 35 years without undergoing any basic change.

In the second case, the history indicates that the papilloma originated on the tracheal wall. This suggests that the second site of the tumor on the vocal cord above was an implantation. This supports the idea that infection plays a rôle in the etiology of a papilloma.

#### SUMMARY.

A case is reported of a papilloma of the larynx becoming evident in a boy at the age of 5 years and increasing in early adolescence so as to cause obstruction requiring tracheotomy. In spite of surgical removal at the age of 12 years and again at 28 years, there is evidence that papillomatous tissue existed in the larynx for 35 years without undergoing basic change. The long presence of this tumor keeping the cords apart apparently resulted in a *dysphonia plicae ventricularis*, and this in turn contributed to the development of an *internal laryngocoele*. Surgical treatment of the papilloma and of the laryngocoele when the patient was 40 years of age resulted in a cure of these lesions. The *dysphonia plicae ventricularis* persisted but the patient has a useful voice.

A second case describes the occurrence of a papilloma in

the trachea of an adult of 53 years of age. This caused a weakness of the tracheal wall resulting in herniation. Subsequently, a second papilloma developed on a vocal cord above, indicating that an implant occurred. These were removed surgically by direct laryngoscopy with a cure of the hoarseness.

The etiology, the possible endocrine factor in the papilloma of children, and the question of a precancerous aspect in papilloma in an adult are discussed.

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#### AMERICAN BOARD OF OTOLARYNGOLOGY.

The next examination of the American Board of Otolaryngology will be held in New York at the Waldorf-Astoria Hotel and the New York Eye and Ear Infirmary on June 3-4-5, 1943. Direct all inquiries to Dr. D. M. Lierle, Secretary-Treasurer, University Hospital, Iowa City, Iowa.

## OSTEOPHYTES OF THE MAXILLARY SINUS.\*†

DR. L. W. DEAN, JR., and DR. WM. H. DIEHL, St. Louis.

To quote directly from Zuckerkandl, "In chronic catarrh the mucus membrane, including the periosteal layer, of the maxillary sinus undergoes an inflammatory change; a periostitis occurs which results in hyperostoses of the sinus wall in the form of scale-, rod- and net-shaped pieces of bone studding the sinus wall. Bony plates at first lying loose in the periosteum later merge with the bony wall and give rise to the irregularity which one so often sees in the wall of the maxillary sinus. When one makes preparations of such a sinus lining he sees bone formation in all stages of development. The younger products lie in the periosteum; other larger ones are in contact with the bony wall; still others stick to or lie loose upon the latter, while the oldest formations have become fused with the maxilla.

"One sees this bone formation occur with great frequency in chronic catarrh, and not at all rarely does a single large bony plate have no connection with the superior maxilla and, remaining after the draining away of the infection, lie loose in the lining of the maxillary sinus.

"I consider the bony plates of the maxillary sinus periosteum as the earliest anlage of those very interesting osteomata which have no attachment to the bony sinus wall and lie free in the sinus. There occur in the antrum not only bony tumors on the wall but osteomata of another sort which are not attached to the bony wall. When I found bony plates in the sinus lining I remembered a reference to them in Tillaux' topographical anatomy and found there a passage which said that already Dolbeau had recognized osteomata of the maxillary sinus lying free in the periosteum. The passage said: 'The mucosa which lines the nasal cavities, the ethmoid cells and the sinuses presents this same characteristic of being composed on its deep surface of a fibrous sheath which blends with the periosteum.

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"This fibrous sheath is capable of becoming ossified and of giving rise subsequently to veritable bony tumors occupying the different cavities of the face. From this resolves the fact, of great importance from the point of view of surgery, that the exostoses thus developed are free in the cavities which they occupy and are *contiguous* only with the bony parts of which they are entirely independent.'

"M. Dobleau stressed the pathogenesis of these osteomata in a treatise read before the Acadmy of Medicine in 1866, and I can do no better than to reproduce some of the conclu-

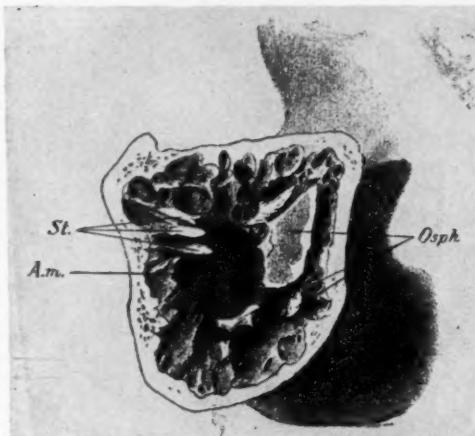


Fig. 1. (From Killian in Heymann's Handbuch.) A drawing of the interior of a maxillary sinus containing osteophytes. (st) Osteophytes attached to the bony sinus wall. (ospk) Osteophytes lying free in the cavity of the sinus. (A.m.) Maxillary sinus with thickened wall.

sions of this author: 'The Schneiderian membrane which lines the different sinuses and cells adjacent to the nasal fossae may become the seat of primitive bone formations, tumors which are independent of the bones of the skull and of the face but which may nevertheless acquire great size.'

"All the exostoses are more or less free in the cavities in which they originate; they may, in developing, coalesce in a manner more or less solid, but they always remain distinct from the bones and can be removed provided a large enough opening is made; thence the indication for operating early."

Killian (see Fig. 1) describes osteophytes in the thickened

membrane of the maxillary sinus, and states that as a rule the pieces of bone are numerous and small and vary widely in shape and size.

The following two case reports illustrate types of osteophytes which may be found.

*Case 1:* H. S., a 23-year-old white woman, came to the dispensary complaining of difficulty in hearing, tinnitus and a purulent nasal discharge. There was pus in each middle meatus. The left middle turbinate was covered with polypoid hypertrophies and there was a pedunculated edematous polyp in the right middle meatus. Sinus X-rays revealed complete opacity of both maxillary sinuses. Irrigation of the maxillary

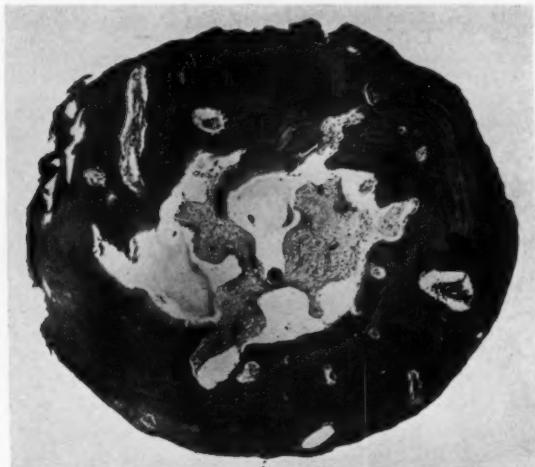


Fig. 2. Round osteophyte shelled out of the sinus mucosa of Case 1.

sinuses yielded pus from both sides from which *H. influenza* was the only organism grown.

Repeated irrigations and other conservative measures failed to bring about any improvement of the sinusitis.

The right maxillary sinus was opened through a canine fossa approach. The mucous membrane was thick, polypoid and boggy. Free pus was aspirated from the cavity of the sinus. When piece of mucous membrane was removed from the outer angle of the sinus and placed on the Mayo table, a round, pearly, hard object about 2 mm. in diameter rolled free of the mucosa. Further search revealed five such objects lying within the mucosa of the sinus.

When placed in Zenker's fluid, two of these disintegrated but the remaining three remained intact and hard.

*Microscopic Study:* The mucosa of the maxillary sinus was covered with pseudostratified columnar ciliated epithelium lying upon a thick, pale basement membrane. The tunica propria was very edematous, the

connective tissue strands being forced apart by collections of fluid. There was an infiltration of plasma cells, lymphocytes and a few neutrophiles and eosinophiles. Some areas of proliferation of young fibrous tissue and blood vessels were present.

The second portion of the specimen consisted of three round, smooth pieces of bone. The lamellae were generally concentric about the center of each nodule. The osteocytes stained well. A delicate outer periosteum could be demonstrated in some areas but in others the periosteum was either stripped off or was not formed (see Fig. 2).

At a later date this patient had a Caldwell-Luc operation performed on the left maxillary sinus, at which time a similar type of mucosa was encountered but no osteophytes were found.

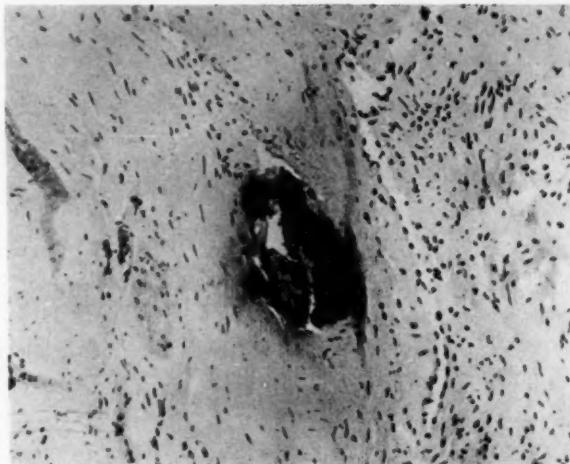


Fig. 3. Bone formation in the sinus lining of Case 2.

The second case illustrates a common type of osteophyte formation, that in which a small plate of bone develops in the periosteal layer of the mucosa.

*Case 2:* E. D., a 27-year-old colored woman, was seen by the ear, nose and throat service because of the presence of bronchitis with early cylindrical bronchiectasis. There were no symptoms of sinus disease and examination of the nose revealed no gross abnormalities. X-ray studies of the sinuses, however, showed the right antrum to be completely opaque. Three attempts at irrigation through the inferior meatus were unsuccessful because no fluid could be introduced after the needle entered the sinus.

An exploratory Caldwell-Luc operation was performed. The antrum was found to be nearly completely filled with a dense fibrous tissue lining, the lumen of the sinus being extremely small.

*Microscopic Study:* No epithelium or basement membrane was seen. There were three thick pieces of dense fibrous tissue containing areas of hyalin degeneration. In one of the pieces of fibrous tissue was a piece

of bone. Since decalcification was not performed, the bone was fragmented, but appeared to be viable (see Fig. 3).

One gets the impression from reading the older German authors that osteophytes in the maxillary sinus were found very commonly. Either they are rare at the present time or are unrecognized or unreported. The hypothesis of Dolbeau, as reported in the beginning of this paper, that osteoma of the sinus may arise from such an anlage is interesting. He mentions that a fibrous line of cleavage should exist between the osteoma and the sinus wall, a condition which would greatly facilitate the avulsion of such bony tumors if an adequate exposure could be obtained and the tumor grasped by a large, strong forceps.

*Summary:* A review of the literature on osteophyte formation in the sinuses, along with two case reports illustrating two types of osteophyte formation in the maxillary sinuses has been presented.

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#### ANNOUNCEMENT REFRESHER COURSE IN LARYNGOLOGY, RHINOLOGY AND OTOTOLOGY, MARCH 22 to 27, Incl., 1943, UNIVERSITY OF ILLINOIS COLLEGE OF MEDICINE.

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## NEUROLOGY IN OTOLARYNGOLOGY.

DR. HANS BRUNNER, Chicago.

In the following review, not all articles mentioned in the bibliography are abstracted. Only those articles are chosen which in the opinion of the reviewer are of particular interest.

### 1. CLINICAL FUNCTIONAL TEST AND DISEASES OF THE LABYRINTH AND VESTIBULAR NERVE.

In 1911 Bauer and Leidler found that following the removal of one cerebral hemisphere in the rabbit, the cessation of rotation toward the side of the intact hemisphere, *e.g.*, the right, evoked a much brisker nystagmus than the cessation of rotation in the opposite direction. Bauer and Leidler interpreted their finding as an exaggeration in the response of the left labyrinth, and were led to the general conclusion that ablation of a cerebral hemisphere gives rise to an increased sensitivity of the homolateral labyrinth. In 1923 Dusser de Barenne and de Kleyn were able to confirm the facts as stated by Bauer and Leidler, but refuted the explanation offered. It was made apparent that what in fact had been brought about by extirpation of the left cervical hemisphere was not increased sensitivity of the homolateral labyrinth; it was rather a central facilitation of induced labyrinthine nystagmus in a particular direction, *viz.*, in the direction toward the removed cerebral hemisphere. This finding was called by the reviewer "oculomotoric hyperexcitability," in contradistinction to the labyrinthine hyperexcitability.

Fitzgerald and Hallpike<sup>12</sup> made an attempt to obtain further evidence of the occurrence of directional preponderance of induced labyrinthine nystagmus attributable to cerebral lesions in humans. Employing an improved technique of the caloric test, they found that in all of the cases with lesions of one temporal lobe direction preponderance of caloric nystagmus was observed to the side of the lesion. In all of the 10 cases with lesions which did not involve the temporal lobes, the caloric reactions were normal.

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In a second paper, Cawthorne, Fitzgerald and Hallpike<sup>8</sup> employed the same technique of caloric test on nine subjects in whom unilateral destruction of the labyrinth by surgical measures had been carried out on account of intractable vertigo due to Ménière's disease. Following the subsidence of postoperative nystagmus, the responses of the unoperated ear revealed in all nine cases a marked directional preponderance of caloric nystagmus to that side, diminishing with time.

The statement of these facts is followed by a long discussion of purely theoretical interest which leads to the final conclusion that not the unidirectional, *viz.*, the ampullopetal but a bidirectional sensitivity to endolymph flow is characteristic of the canal cupula of the intact human subject. Its conversion into an abnormal unidirectional sensitivity by unilateral labyrinthectomy is attributed to the elimination of tonic impulses, chiefly of utricular origin. This "utricular paresis" is supposed to be the cause of the directional preponderance of caloric nystagmus to the healthy side, following labyrinthectomy.

It is difficult to accept these conclusions. Ewald stated his law concerning the unidirectional sensitivity of the ampullar crista on the base of exact experiments, while the authors based their concept of the bidirectional sensitivity upon theoretical speculations. Further, the authors claim the human utricle as much the most important source of the tonic impulses which reach the vestibular centers from the labyrinth. This concept is possible, but the fact that the utricle exercises that function in frogs, dogfish and pigeons does not imply the conclusion that the utricle exercises the same function in human.

Without going into further details, the reviewer, on account of his studies of the bilateral calorization, still holds the view that the cause of directional preponderance of caloric nystagmus does not concern the labyrinth ("utricular paresis"), but the brain stem. If the right labyrinth was removed, there is a spontaneous nystagmus to the left which lasts for several weeks; however, even after the disappearance of that nystagmus there is still a latent tendency present for this type of nystagmus. In other words, even after the disappearance of the nystagmus to the left, slight stimuli, which even

do not originate in the labyrinth, as the exclusion of fixation by means of the spectacles of Frenzel, are sufficient to render the nystagmus to the left again manifest. Under the circumstances it is obvious that hot stimulation of the left ear or cessation of rotation to the right, *viz.*, all stimuli which produce a nystagmus to the left and thus present an additional stimulation to the latent tendency for that type of nystagmus, must be more effective than the contrary stimuli.

In a third paper, Cawthorne, Fitzgerald and Hallpike<sup>4</sup> deal with the caloric test in Ménière's "disease." First, they state that Ménière's syndrome should be considered as a disease process *sui generis* of the labyrinth, the essential mechanism of which is an obstructive distension of the endolymph system. Fifty cases suffering from Ménière's syndrome were examined. Loss of cochlear function was observed in all cases and in 86 per cent of cases it was bilateral. The essential bilateral character of the disease process is accordingly stressed. The deafness was nearly always of the internal ear type. No evidence was found in support of the view that tympanic disease or oronasal foci of infection play an important rôle in the etiology of the disorder. The caloric reactions showed the presence of a vestibular lesion in 47 of the 50 cases. In the majority of these, the vestibular lesion was on the side where the hearing was diminished. In five cases, however, the vestibular lesion was on the side where the hearing was better. There were three well defined types of unilateral vestibular lesion:

1. Paretic lesions of the utricle in 10 cases characterized by a directional preponderance of caloric nystagmus in the direction of the intact utricle.
2. Paretic lesions of the external semicircular canal in 29 cases characterized by a diminished excitability of the labyrinth on the affected side for hot as well as for the cold stimuli.
3. Paretic lesions of the utricle and external semicircular canal occurring in combination in eight cases, characterized by the occurrence of an appropriate combination of the caloric reaction patterns mentioned above.

In an excellent paper Lindsay<sup>21</sup> deals with the interrela-

tion of labyrinthine dropsy and Ménière's disease. His case concerned a man, 67 years old, with a deafness which from the clinical point of view would have been considered as an arteriosclerotic lesion of the internal ear. There was no evidence whether or not the patient suffered from dizziness. The right side of the cochlear duct was extremely dilated at the expense of the scala vestibuli. Corti's organ and the nerve elements were normally preserved except for the hair cells which showed extensive degeneration. There was an extensive dilatation of the sacculi which overlay the footplate of the stapes. The utricle was dilated and had herniated into the small ends of the semicircular canals, so that the utricular wall lay beside the membranous walls of the canals, and had also herniated at the ampullae of the posterior vertical and horizontal canals in such a way as to distort and displace the wall of the ampullae opposing the cupula and crista. Dilatation of the endolymphatic duct and sac was moderate. The lining epithelium in the central part of the endolymphatic duct was well preserved. The convolutions and the surrounding connective tissue were somewhat reduced. The pathological changes on the left side corresponded closely to those of the right side, but the dilatation of the saccule and the herniation of the utricle were considerably less extensive.

Dilatation of the membranous internal ear is by no means very rare, although it is as a rule due to an inflammation. In the case of Lindsay, as well as in eight other cases of the literature, there was absence of any evidence of disease of the middle ear or of the labyrinth capsule, of inflammatory reaction in the perilymphatic spaces or of a blockage in the cochlear aqueduct; furthermore, in Lindsay's case, there was certainly no interference with absorption of endolymph on the left side. Lindsay, therefore, believes that vasomotor instability may be the basis of the ectasia, although he does not specify the relationship between the vasomotor instability and dilatation of internal ear.

Inasmuch as there was no history of vertigo in Lindsay's case, the author states that labyrinth dropsy of an unknown cause may be found in cases of true Ménière's syndrome and in cases in which deafness of the same type is present, but there is no history of attacks of vertigo; however, it is characteristic of Ménière's syndrome, the frequent disappearance

of vertigo after a few years while the deafness continues or progresses, as Lindsay states correctly. In cases of long-standing disturbances, as in the case of Lindsay, the full syndrome may have been present at an earlier stage.

It is in favor of the concept of Lindsay that the dilatation of the internal ear as it is presented in the microscopic specimen indicates an ectasia which is no more reversible, which is rather fixed by adhesions. Although it is not always easy to see these adhesions, one must assume their presence, inasmuch as in the opposite case the membranes of the internal ear would have fallen back, due to the sinking force of the heart in the last hours of life. As a matter of fact, in reversible ectasias the Reisner's membrane can be seen in almost normal position, but presenting folds; therefore, the ectasia found in the case of Lindsay presents a stationary condition and it is difficult to believe that a stationary condition in the internal ear produces transitory symptoms as attacks of vertigo.

Unfortunately, Lindsay does not stress the fact that in his case the utricle was dilated. This is an exceptional finding, as from anatomical reasons the dilatation usually concerns only the inferior part of the inner ear; *viz.*, cochlea and sacculus.

Although the specimen of Lindsay's presents a fixed dilatation of the internal ear, it is certainly an acceptable explanation that the irreversible dilatation is due to repeated attacks of reversible dilatations which, in turn, explain the auditory disturbances as well as the attacks of vertigo.

Johnson<sup>14</sup> reports three cases of Ménière's syndrome which did not respond to the Furstenberg treatment, which were relieved as far as dizziness was concerned by sectioning the nerve. He emphasizes correctly that spontaneous remissions occur, lasting from a few months up to 12 years. Because of these spontaneous remissions it is difficult to evaluate treatment.

Cinelli<sup>5</sup> reports a case who presented the syndrome of the posterior inferior cerebellar artery. Inasmuch as the case was only clinically observed, the diagnosis is not absolutely sure. The author claims that the presentation of this syn-

drome to the otolaryngologist is permissible, "as a careful search in the otolaryngologic literature reveals nothing on this subject." That statement is apparently an exaggeration. The syndrome of the posterior inferior cerebellar artery is by no means extremely rare and there are cases on record, clinically and microscopically examined by otolaryngologists, although it certainly would be desirable to increase the number of such cases. As an example, I quote the case of Campbell and Grabscheid (*Arch. f. Ohrenheilk.*, 140:309, 1936).

Grove<sup>13</sup> presents an excellent review concerning the otological symptoms of craniocerebral injury. The author emphasizes that the caloric test should not be performed if there is an outflow of blood or cerebrospinal fluid from the ear. The reviewer omits the caloric test in any case of recent head injury, regardless whether there is an outflow from the ear or not. Grove further states that the caloric test cannot be used when there is a pre-existing spontaneous nystagmus in the central position of the eyes, nor is it of any value under these conditions. It is not clear what Grove has in mind. If a spontaneous nystagmus of second degree is present, the caloric test must be simply intensified to produce a nystagmus of third degree. As far as the treatment is concerned, the author states that a radical mastoid operation should be done as soon as the patient is over the shock and the fracture line should be exposed if a fracture occurs through a chronically discharging ear. If ever, after a transverse fracture of the pyramid, a middle ear suppuration should supervene, a radical mastoid operation should be done at once.

Although several otologists agree with these indications, the experience of the reviewer points to more conservative measures. As far as chronically discharging ears are concerned, I have observed 17 cases of that type which were due to severe head injuries, some of them even with outflow of cerebrospinal fluid from the discharging ear. All these cases recovered without surgery. It seems, therefore, that in these cases all depends on the type of chronic suppuration and on the occurrence of a superinfection of the middle ear, due to the injury. In patients who suffer from a pre-existing chronic infection of the Eustachian tube with a perforation in the anterior and inferior quadrant of the drum, surgery can be frequently avoided unless a superinfection produces a flare-up

of the otitis. On the contrary, in instances with a perforation in the posterior and superior quadrant or in Shrapnell's membrane, a radical mastoid operation as a rule must be done; however, even under these circumstances every case should be treated according to individual findings.

The reviewer does not believe that a radical mastoid operation should always be performed in cases suffering from a transverse fracture of the pyramid and a supervening acute otitis, inasmuch as these cases as a rule lead to a rapidly progressive meningitis. If surgery is the chosen treatment, the sequestrum of the pyramid must be removed, which as a rule includes an opening of the labyrinth; however, on account of the dubious prognosis of these cases, sulfa-drugs should be tried.

## 2. PAINS IN THE FACE AND IN THE NECK.

Klemme and Woolsey<sup>18</sup> present an excellent review about trigeminal neuralgia. The disease started in 98 per cent in either the maxillary or mandibular branches and spreads to the ophthalmic division, the latter being involved in about 2 per cent of the cases. About one-half of these patients have the so-called trigger-zone. These are small areas at the vermillion border of the lips or on the outer edge of the tongue, stimulation of which by hot or cold air, hot or cold water, can often be relied upon to produce the pain in question. Trigger zones are not necessary, however, for a diagnosis of trigeminal neuralgia, but a person who demonstrates the painful area by laying his hand on the whole side of the face rarely has trigeminal neuralgia. The etiology of this condition is thus far unknown. Vitamin B gives temporary but never permanent relief; so does typhoid vaccine or tretylene inhalant. Alcohol injections and peripheral neurectomy should be abandoned as being palliative procedures only. The correct operative treatment of major trigeminal neuralgia is the subtotal resection of the connecting fibres of the sensory root between the Gasserian ganglion and the central nervous system preserving the ophthalmic fibres and the motor root.

Very different symptoms are presented by the sphenopalatine ganglion neuralgia as described by Eagle.<sup>10</sup> There seems to be a preponderance in patients of the ages between 30 to 40 years. The disease occurs in females in a ration of 2-to-1

and seems to be restricted to the white race. Intumescence of the nasal mucous membrane is the immediate cause of the stimulation of the ganglion. There are three primary etiologic factors for this intumescence:

1. Intranasal deformities (deviation of septum, ledges, spurs, prominent turbinates, adhesions, osteoma).
2. Systemic disorders including toxemia, anemia and fatigue.
3. Primary neurosis, hysteria and other emotional manifestations.

The symptoms consist of facial pain (not of headache) which never extends above the level of the ear. There are usually two main points of maximum pain, one in the region of the orbit and the root of the nose, and the other in the region just posterior to the mastoid process. Occasionally the pain extends on into the neck and in extreme cases from the top of the shoulder to the elbow. Tinnitus with dizziness indicates obstruction of the tube and is not frequently described. The diagnosis is conclusive if the symptoms are relieved within one to three minutes by cocaineization of the sphenopalatine ganglion on the affected side.

In trifacial neuralgia there is usually a trigger zone for the origin of the symptoms and the pains are lightning-like in duration. Some patients demonstrate the temporomandibular joint syndrome in addition to sphenopalatine ganglion neuralgia; however, in the latter there is usually a history of dental extractions in the molar region about the time of the onset of the symptoms; further, the symptoms can be alleviated by preventing the rotation of the mandible in the temporomandibular joint, by the use of corks, disks, etc., which will hold the lower jaw as far apart from the upper jaw as it was previous to extractions. In elongations of the styloid process most of the symptoms are referred to the aural region and the lateral wall of the pharynx rather than to any region about the orbit and bridge of the nose.

The treatment should always be most conservative, as, application of 10 per cent cocaine to the ganglion. One application may give permanent relief. Spraying the nose with a 1 to 3 per cent solution of butyn sulfate frequently alleviates

the pain. When the symptoms continue, the fracturing and displacing laterally the middle turbinate, submucous resection, ethmoid operation come into consideration. Finally, injection of 0.5 cc. of 5 per cent phenol in 95 per cent alcohol into the ganglion may be used, but most often the septum resection is sufficient.

Whereas the trifacial neuralgia is a well defined entity, the characteristics of the sphenopalatine neuralgia are less marked and, thus, it must be admitted that there are gradual transitions between the disease called sphenopalatine neuralgia and the so-called atypical facial neuralgia, the latter consisting of a pain not limited to the distribution of a cranial nerve but occurring back of the eye, over the zygoma, cheek or nose, over the mastoid region and down the neck. In one case of that type, a resection of the sphenopalatine ganglion was performed by Martin<sup>23</sup> but did not give complete relief.

A certain type of atypical facial neuralgia is related to dysfunction of the temporomandibular joint. Costen<sup>9</sup> mentions the following symptoms: burning sensations in the tongue and in the pharynx (23 per cent of cases), salivary disturbances, herpetic eruptions in the buccal mucosa and external ear, stuffy sensations and tinnitus and diminution of hearing. So far as the latter symptom is concerned, Costen proved that by overclosing the lower jaw of a soft tissue specimen, the soft tissues bulged toward the tube and closed it by pressure on its membranous anterior wall; however, in the more recent part of his series, the results of audiometric tests made on all patients complaining of deafness did not confirm the improvement after treatment noted when voice tests were used.

As the last symptom related to dysfunction of the temporomandibular joint, Costen mentions the trismus, the inciting factor of which is supposed to be any sensory stimulus occurring in areas supplied by the third division of the Vth nerve. The cases of trismus were classified in five groups, according to the origin of the sensory irritation: 1. Sources of inflammatory irritation about the ears and jaws, such as carious teeth, infection of the external auditory canal; 2. trauma delivered primarily to the temporomandibular joint as by a blow on the chin, enforced stretching of the joints by new

dental plates, subluxation after a wide yawn, etc.; 3. gradual destruction of the joint, the result of various forms of mal-occlusion of the original teeth; 4. the subpainless stimulus originating in impacted molars; 5. actual destructive lesions slowly produced in the mandibular joint.

Another type of atypical facial neuralgia is related to an elongated styloid process, resembling a glossopharyngeal neuralgia. According to Loeser and Cardwell,<sup>22</sup> in these cases the pain is referred to the malar bone, the tonsillar region, the ear and the shoulder, but the reviewer observed also pains in the eye, forehead and cheek in these cases, indicating an involvement of the Vth nerve. In one case Loeser and Cardwell have removed the elongated styloid process by an approach from outside, but it should be mentioned that in cases in which the styloid process extends into the tonsil, it can be removed, after tonsillectomy, from the mouth.

In several patients complaining of a severe sore throat, marked pain on swallowing and occasional attacks of hoarseness, these complaints having been present for several months to several years, Williams and Elkins<sup>31</sup> made the diagnosis of a myalgia of the pharynx. So far as the symptomatology is concerned, the authors found on inspection some of the usual signs of inflammation of the upper part of the respiratory tract; furthermore, there was: 1. tenderness over the styloid process and over the tendinous loop of the insertion of the digastric muscle to the body of the hyoid and the insertion of the stylohyoid muscle at the hyoid bone; 2. tenderness at the junction of the anterior pillar of the tonsillar fossa with the base of the tongue; 3. tenderness of the mylohyoid muscle; 4. tenderness over the ala of the thyroid cartilage; 5. tenderness along the lateral margins of the thyroid membrane; 6. tenderness on the posterior surface of the larynx; 7. occasionally involvement of the superior constrictors.

The treatment of that not too well defined disease consisted of heat and massage, while even excessive doses of acetylsalicylic acid as a rule were not effective (in contradistinction to primary fibrositis of the neck). It would be interesting to know how many of the mentioned symptoms indicate a *globus hysterius*, a diagnosis, which, of course, should always be made with great caution.

Clerf and Putney<sup>6</sup> present a very interesting study con-

cerning the cricopharyngeal spasm. With our present diagnostic aids, it is difficult to demonstrate dysfunction of the cricopharyngeus muscle. In the presence of disease of the cervical esophagus, as carcinoma or foreign body, and in chronic hypopharyngitis it is reasonable to assume that incoordination of the swallowing function does occur; however, it is not always possible to differentiate between this and the changes produced by the disease itself; further, it cannot be ascertained whether reflex stimulation is producing increased involuntary tonic contractions (spasm) of the cricopharyngeus or there is lacking the necessary stimulus to relax the normally contracted sphincter. In addition, the circular muscle fibres of the upper esophagus, which are striated and receive practically the same innervation as the cricopharyngeus, have a related function and probably participate in the mechanism of incoordination of the upper esophageal constrictor. One, therefore, should consider in the differential diagnosis, carcinoma, foreign body, pulsion diverticulum, congenital or acquired stenoses, chronic hypopharyngitis, chronic esophagitis, cardiospasm, disturbances of the thyroid gland and a host of other conditions about the neck and upper mediastinum. Certain laryngeal disturbances also may give rise to indefinite symptoms referable to the swallowing act.

Jones<sup>16</sup> presents an exhaustive review about the autonomic nervous system. He emphasizes the difference between vagotonic and sympathetictonic individuals, the first indicating persons who react strongly on pilocarpine or atropine, less on adrenalin, the latter indicating persons who respond in a reverse manner. The reviewer, however, agrees with those internists who do not stress much importance on the difference between these two groups of individuals.

Jones further mentions experiments consisting of blocking the stellate ganglion. Pain in hemicrania was relieved, but not regularly, dizziness was aggravated in some and stopped in others. Tinnitus was affected the same way, but two patients immediately volunteered the information that they could hear better. All effects of the ganglion block were transient.

Hypotension in the carotid artery stimulates the sympathetic plexus or carotid sinus and there follows a consequent

rise in blood pressure. Any constriction around the neck of an individual with a hypersensitive carotid sinus wall can cause attacks of syncope.

The reviewer observed in a woman, 30 years old, suffering from an osteomyelitis of the occipital bone, the following symptom: Immediately after an operation of the skull, the patient noticed tinnitus and a diminution of hearing on the right (healthy) side, which was particularly marked in the sitting position. Hearing, as well as tinnitus, improved if the patient was in the reclining position or if pressure was exercised on the right carotid artery. The improvement of hearing during pressure on the carotid artery was proved by the audiometric examination. Pressure on the carotid also produced dizziness but there was no nystagmus. Six days after the operation all these symptoms had disappeared.

Taylor<sup>30</sup> describes a case concerning a man, 51 years of age, who was given a prophylactic dose of tetanus antitoxin within two hours after receiving a laceration of the finger. The wound healed normally, but a general anaphylactic reaction developed five days afterwards and was followed in approximately six hours by bilateral deafness of a high degree. Neither nystagmus nor vertigo was present when both ears were irrigated with tap water with the patient upright and then bent forward. Horizontal nystagmus to the left was observed for approximately 35 seconds when the patient in an upright position was turned 10 times to the right, and it was noted for about five seconds longer in the opposite direction when the corresponding turning test to the left was made. This aural condition has continued without improvement and appears to be the direct result of the injection of tetanus antitoxin.

Stock<sup>24</sup> describes a case of herpes zoster oticum with involvement of the Vth, VIIth and VIIIth nerves. Treatment included administration of thiamine hydrochloride and vitamin B complex and galvanic muscle stimulation. There was a great improvement of hearing, while the vestibular branch and the facial nerve on the affected side did not regenerate in a period of nine weeks. This, again, is an example which proves that the general statement indicating that the cochlear nerve is more sensitive against injuries of any type than the vestibular and facial nerve is not correct. Although in many types of injuries (arteriosclerosis, poisoning with salicylates, etc.) that statement might be correct, it cannot be promulgated as a general law.

### 3. OLFACTORY NERVE.

Elsberg<sup>11</sup> and his associates continued the important work concerning the function of the olfactory nerve in neurologic disorders, describing the olfactory-parotid reflex. Elsberg, Spotnitz and Strongin found that the resting rate of secretion of the parotid gland was normal in 56 per cent of a series of 64 patients with neurologic disorders. Stream injection of the odorous substance, citral, into the nasal cavity produced a definite increase in the volume of secretion from the ipsilateral parotid gland in normal human beings. The effect on the contralateral parotid gland was less marked. The authors suggest that the reflex response of the parotid glands on stimulation of the nasal mucosa with odorous substances should be called the olfactory-parotid reflex. There is evidence to support the view that the afferent pathway of the reflex is not in the olfactory nerve but involves the Vth and VIIth cranial nerves. Neurological disorders produce overactivity and underactivity of the reflex. There is some evidence that the cerebral pathways which affect the reflex cross in their course from the cerebral cortex to the brain stem.

### 4. RHINOGENIC RETROBULBAR NEURITIS.

In 27 cases of retrobulbar neuritis Costen<sup>8</sup> noted the following principal contributing factors: remote foci in six, alcohol in three, brain tumor in two, sinus disease in eight, systemic diseases in three, complicating allergy in two. Of the 27 cases with a diagnosis of retrobulbar neuritis, the condition of eight was improved by sphenoethmoidectomy, six were improved by typhoid and fever therapy, two made a spontaneous recovery with no treatment. Costen stresses the point, whatever is done for the relief of retrobulbar neuritis or extensive acute retinal lesions, in the way of sinus surgery or removal of foci, should be promptly carried out, damage to the optic nerve being rapid and commonly followed by permanent residual atrophy. The reviewer has recently emphasized that in patients with a retrobulbar neuritis, in whom the affection of the optic nerve progresses rapidly, the opening of the paranasal sinuses frequently fails to stop the degenerative progress unless there is definite pathology in the paranasal sinuses. The reviewer, therefore, believes that in the majority of cases of retrobulbar neuritis, the damage

to the optic nerve does not progress rapidly, leading to a permanent nerve atrophy. But if there is a case in which the neuritis of the optic nerve actually progresses rapidly, the opening of the paranasal sinuses unfortunately has only little effect unless there is marked pathology in the sinuses.

##### 5. TONSILS AND POLIOMYELITIS.

Seydell<sup>27</sup> presents a very critical review concerning the relation of tonsillectomy to poliomyelitis which has convinced him that that relationship cannot be determined without further study. It is probably safe to say that tonsillectomy has no bearing on the incidence of the spinal form of poliomyelitis, while there might be some relationship between tonsillectomy and the bulbar form of the disease.

Although I did not observe an epidemic of poliomyelitis, I entirely agree with Seydell concerning the social and practical importance of the problem. Particularly the relation between tonsillectomy and the bulbar type of poliomyelitis is a very serious question, inasmuch as several pediatricians consider tonsillectomy as a predisposing factor for the development of poliomyelitis. There are two cases which I have observed, and which are of interest in that respect.

The first case concerned a white woman, 24 years of age, who presented, several hours after a typical tonsillectomy, a high fever, nausea and whirling dizziness. On the following day a myringitis bullosa acuta with diminution of hearing, dizziness and positional nystagmus was found. The finding of a myringitis bullosa is of interest as that disease, as well as poliomyelitis, is supposed to be due to a filtrable virus. The positional nystagmus pointed to an affection of the medulla oblongata, but there were no other bulbar symptoms. After several days, all symptoms disappeared and the patient made an uneventful recovery.

The second case is more interesting because an autopsy was performed. It concerned a girl, 16 years of age, who, since her birth, suffered from a patent Ductus Botalli and had in childhood scarlet fever, serum disease, rheumatism and otitis media acuta. She entered the hospital for a chronic tonsillitis and after consultation with the heart specialist a tonsillectomy was performed, which was followed by an uneventful recovery; however, 14 days after the operation she became ill with a high fever and difficulty in swallowing. The examination revealed that the tonsillar region was entirely healed, but there was enormous salivation and, as the patient was unable to swallow, the entire hypopharynx became filled with saliva. The larynx could not be visualized but the tips of the arytenoids emerging from the saliva presented normal motion. There was a certain degree of dyspnea because of the patient's inability to cough up the saliva. There was a rigidity of the neck, a slight paresis of the right abducens, a slight paresis of the right facial nerve, a deviation of the tongue to the left, some hyperesthesia of skin, definite Kernig's symptom marked abdominal reflexes, marked cyanosis, but there were no symptoms from the pyramidal tracts. On the

following day there was a bilateral bronchitis, an increasing dyspnea and cyanosis, vomiting occurred and in the spinal fluid there was a positive Pandy's reaction, but no increase of cells. Sixteen days after the tonsillectomy, the patient expired.

At the autopsy, the vault of the skull was found to be very thick and presented erosions on the inside. The leptomeninges were hyperemic, the cerebral gyri flattened. The cerebral substance was hyperemic and edematous. There was a pneumonia in the right lower lobe, a serous pericarditis and a patent ductus Botalli. There was no other pathology.

The microscopic examination revealed a diffuse encephalitis of the medulla oblongata, the inflammation reaching its climax in the nuclei, close to the ventricle, as in the nucleus of the hypoglossus and vagus. But there was also a marked inflammation in the reticular substance, particularly in the area of the N. ambiguus. The infiltrating cells were lymphocytes, but there were no bacteria. In other parts of the brain there was only hyperemia. The spinal cord was not examined.

In my opinion, both cases do not prove that the tonsils must be considered as protective organs against an infection of the medulla oblongata but apparently they prove that by means of a tonsillectomy an infection, probably a virus infection, can be carried into the medulla as well as into the ear, and I believe that this concept agrees with the findings of Seydell; however, it seems that also in streptococcal infections of the tonsils, particularly in peri- and retrotonsillar abscesses, the infection might be occasionally carried into the brain stem. I saw three cases of that type in whom in the course of an infection of the tonsils with subsequent blood stream infection dysarthria, abducens paresis, ataxia, spontaneous nystagmus, slow and scanning language and adiakokinesis were observed. One of these cases was cured by administration of prontosil, the two other cases (one with hemolytic streptococci in the blood) expired. In both of the latter cases, a hyperemia and an edema of the brain were found. There was no definite encephalitis in the brain stem, particularly in the medulla oblongata; however, it is probable that serial sections through the brain stem (which were not made) would have revealed an encephalitis. It is noteworthy that all five instances concerned women.

#### 6. NEUROLOGY OF LARYNX.

Mulligan<sup>24</sup> examined 32 patients with laryngeal paralysis following thyroidectomy. Thirty of them had a partial lobectomy on both sides; from each of the other two an adenoma was removed. In 24 cases the paralysis was unilateral, on the right side in 14 and on the left side in 10 instances. In

eight instances both vocal cords were paralyzed. The recurrent laryngeal nerves were seen in only two of the 32 patients in whom the nerves were injured. In each case it was the left nerve which was exposed and the postoperative examination showed paralysis of the right cord. In patients with unilateral abductor paralysis, the speaking voice definitely improved after two to six months, but the majority complained that after prolonged use the voice became progressively weaker and often faded to a whisper. The singing voice was as a rule lost. Dyspnea on exertion was not a prominent symptom in patients with unilateral paralysis, while it was marked in patients with bilateral weakness of the abductor muscle. Complete recovery of the function of the vocal cord was perhaps observed in one case, although occasionally a change from complete to partial paralysis occurred.

Seed<sup>26</sup> describes at length the operation of King for bilateral abductor paralysis, consisting of an incision through the inferior constrictor muscle, separation of the underlying mucosa from the posterior surface of the thyroid cartilage, cutting through the musculotendinous bundle of the cricoarytenoid muscle, opening of the cricoarytenoid joint and fixing the arytenoid cartilage to the thyroid cartilage. The fixing suture must be placed through the processus vocalis and not through the processus muscularis to furnish a widening of the glottis. The attachment of the omohyoid muscle to the processus muscularis of the arytenoid as originally advised by King should be omitted. The author does not report the results of that operation in actual patients, although it would be very interesting to get information concerning permanent results of this type of operation. It seems that especially the suture through the processus vocalis is rather difficult as far as its permanent effect is concerned. That holds particularly true if the processus vocalis should present an abnormal structure, as the reviewer has found it in the processus muscularis of the arytenoid.

It is interesting, further, that Seed advises to omit the transplantation of the omohyoid muscle. The reviewer has learned from the endoral transplantation of the masseter muscle in facial paralysis that transplanted muscle tissue as a rule does not persist if it is protected only by mucous membrane against an infected space, as the mouth or the hypo-

pharynx; however, if the transplantation of the omohyoid muscle is omitted, also the idea of a functional restoration of the abductor muscle of the larynx is omitted. Under these circumstances the purpose of the operation is simply a widening of the glottis. If that is the case, the reviewer wonders whether that effect could not be easier accomplished by a widening operation on the anterior wall of the larynx than by a similar type of operation on the posterior wall of the larynx.

Guttman<sup>14</sup> calls attention to the frequency of aphasia in children. Thirty cases of cerebral hemisphere lesions in children have been examined with a view to comparing the acquired aphasia in children with adult cases. In all cases under 10 years and in some between 10 to 14 years, the clinical picture was uniformly that of diminished speech production with dysarthria and telegraphic style in the recovery period; this was equally true of cases with frontal and temporal lesions. The latter showed disturbances of speech-reception as well as expression. The recovery from aphasia of the purely motor type is surprisingly rapid and most cases with a reversible lesion have recovered within four weeks. Some cases of aphasia which were submitted to intelligence tests showed very little, if any, impairment; some cases with lesions of the right hemisphere and no aphasia did show retardation of intellectual development. This would point to the brain damage rather than to the aphasia as the factor responsible for the disturbance of intelligence. It is important to keep these findings in mind in examining congenitally deaf children.

#### 7. CEREBROSPINAL FLUID AND ENCEPHALOGRAPHY.

In the last five years the measurement of the electrical currents produced by the human brain has been used as a diagnostic aid. The electroencephalogram or brain wave, as these tracings are called, differs slightly in each individual, but there are two general characteristics that are found in all healthy people: 1. There are two types of normal brain rhythm and all individuals with normal nervous system show various percentages of these two groups. The first, or alpha, waves have an eight to 12 per second frequency, with smooth, regular and clearcut patterns, with voltages from 30 to 125

microvolts. These waves temporarily disappear when the eyes are opened or if one has a problem to work out, such as calculation. The second, or beta, group of normal waves consists of faster frequencies and of lower voltages. They are unaffected by attention or effort. 2. These normal waves are found all over the brain, accessible to the surface electrodes on the scalp, the alpha type being more prominent in the occipital region.

In a brain with neurological disease, particularly where the pathology is near the surface, as in the cortex or white matter under it, very definite electrical disturbances in the brain wave pattern are encountered. Applying the electroencephalogram specifically to the problem of brain abscess, Schwab and Carter<sup>25</sup> have the following data to present: Fifteen cases of proven cerebral abscess were examined. In seven, all electrical focus was found correctly localizing the abscess. In seven others, the brain waves were diffusely abnormal. In only one was a negative examination encountered, and in that the abscess was in the cerebellum. Unfortunately, the authors do not mention how many of these 15 brain abscesses were of otitic origin. The answer to that question might be of importance, as the otitic brain abscess is close to the base of the brain, while the metastatic and traumatic abscess is close to the convexity of the brain, where the deduction of waves seems to be easier than from the base of the brain.

Further uses of electroencephalography to the otologist are: 1. The brain wave changes in the normal alpha rhythm from hearing a sound which might be of some help in working out the diagnosis of malingered deafness from true deafness. The authors, however, are not impressed with the reliability of this because many deaf people hear some notes — particularly loud overtones — and would, therefore show the characteristic disappearance of the alpha waves. 2. In Ménière's disease on the affected side, some fast, high voltage, abnormal activity in the electroencephalogram has been seen in five or six cases, which disappear when the vertigo leaves. This finding has not been constant enough to warrant its recommendation for diagnostic purposes.

Brunner<sup>2</sup> calls attention to the lumbar encephalography in

otorhinology. Lumbar encephalography is indicated in the following conditions: Temporal lobe abscess, frontal lobe abscess, malignant neoplasms of the temporal bone and paranasal sinuses, complications simulating the clinical syndrome of a cerebral abscess, as otitic hydrocephalus, intermittent purulent meningitis and osteomyelitis of the skull.

It is to the great disadvantage of lumbar encephalography that it is followed by a number of symptoms which annoy the patient for a period of several days. In order to diminish these symptoms, Cleveland and End<sup>7</sup> have employed helium in encephalography. When the spinal fluid was replaced by helium gas, the patient was then allowed to inhale pure oxygen until symptom-free. The average duration of symptoms was three and three-quarter hours. When oxygen was used to replace the spinal fluid, and pure oxygen was then inhaled, the symptoms lasted nine hours, or more than twice as long. The symptoms following simple air encephalography as it is usually performed, lasted two and one-half days.

Pentothal sodium anesthesia has proved unsatisfactory for encephalography, as under these circumstances the ventricles are poorly filled. The best results are obtained when local anesthesia only is used preceding spinal puncture. The only advantage of pentothal sodium or general anesthesia is that the patient is not aware of the headache during the immediate procedure.

The authors apparently have in mind the replacement of the total amount of spinal fluid by gas, which procedure is usually employed by neurologists. It should, however, be recalled that in otorhinologic practice this procedure is not advisable, inasmuch as partial replacement of spinal fluid by gas or air furnishes satisfactory pictures.

Kahn<sup>17</sup> advises colloidal thorium dioxide to be used to advantage in outlining cystic tumors of the cerebral hemisphere. This contrast medium is of value in the treatment of encapsulated abscess of the brain. Colloidal thorium dioxide has the advantage over iodized poppy seed oil or air in that it mixes readily with fluid contents and may be phagocytized by the surrounding wall of an abscess so that the capsule itself will be visible in the Roentgen ray within three days or less. There can be little danger in the use of colloidal

thorium dioxide from the effect of long-standing radioactivity since the main mass of this substance is removed in the evacuation of the cavity.

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**SIR ST. CLAIR THOMSON,**

**1859-1943.**

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## IN MEMORIAM

SIR ST. CLAIR THOMSON,

1859-1943.

With the death of St. Clair Thomson, Jan. 29, 1943, at Edinburgh there disappears the leader of laryngology in Great Britain, a throat surgeon who was perhaps the most widely known exponent of his specialty in Europe or in America, and a man much esteemed outside his profession by a large circle of friends at home and abroad. His early travels in Europe; his student days in Vienna, Paris and Lausanne; his seven years of medical practice in Italy and Switzerland; his visits to Canada, America, South Africa, Egypt, India, Ceylon and Burma; and his frequent presence at professional congresses in the capitals of Europe helped to form contacts which were strengthened and continued by his social and hospitable tastes.

Although this all helped to fashion broad views and cosmopolitan tastes, he jokingly used to remark that he had done his best to make himself thoroughly British by having a Highland mother and a Lowland father, by being born in Londonderry, Ireland (July 28, 1859), spending his childhood in Argyllshire, being educated in England and taking his M.D. at London University. He liked to think that he inherited most from his Gaelic-speaking mother, who lived to be 91, and his grandfather Sinclair, of Lochaline, who died at 93. Although he did not quite reach this longevity, certain Celtic tendencies were shown by his romantic outlook, by his views on "the drama of life" or "the poetry of travel," by his fondness for poetry, music and drama, and by an easy command of clear speech and a facility of expression which served him well as writer, lecturer or after dinner speaker.

Until the age of 10 he attended the village school of Ardrishaig in Argyllshire, sharing in mixed classes with the sons and daughters of Loch Fyne fishermen. Realizing how this coeducation could tend to form a good foundation for a spontaneously humane and social spirit and would help to lower class barriers, he was always thankful for the experience and

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manifested his gratitude by frequent visits to Argyll and by his legacies to the school. Here the elements of education, with a love of knowledge for its own sake, together with clearness of thought and speech, were so well taught that he always held that the five years at this village school were the most important of all his years of education, only approaching in value what he learned from his Highland mother. As a consequence, although he entered only the lowest form in the King's School, Peterborough, during the summer term, yet, before the end of the year he was head of it and of every successive form until he reached the sixth. Here he failed, as he left before the year was out in order to commence the study of medicine, in the old-fashioned way of last century, by becoming apprenticed as a pupil to a leading doctor in the town. Here he not only learned to dispense medicines and "keep the books" but he also prescribed for and visited patients — often on horseback — attended confinements, assisted at operations and learned the rudiments of surgery at the local infirmary. In this work he also had good opportunities for studying human nature in all varieties and conditions. During this pupillage he passed the matriculation and the first M.B. of London, both from private study only.

At King's College he gained prizes and scholarships. At the hospital he served a year as house physician and then as house surgeon to the great master of surgery, Joseph Lister. His term of office was during the period when Lister was at the highest point of his career, but still facing the most bitter opposition. In after years his old house surgeon frequently bore witness to the struggle to establish the basis of the marvels of all modern surgery, and he also affectionately and gratefully recorded the extraordinary moral and mental influence which this great teacher exercised on all his pupils. After a resident appointment at Queen Charlotte's Hospital and trips as surgeon on a Castle liner to the Cape, the opportunity arose for traveling on the continent with an invalid of artistic tastes, who had many friends and connections abroad. In this way Thomson saw, under an instructive guide, nearly all the art collections of Europe; visited at most of the British embassies and acquired a wide knowledge of

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men and cities. The tour lasted two years and, toward its end, while passing through Florence, he was invited to settle in practice in that "Winter City," as described by Ouida, afterwards one of his many interesting patients. As the foreign colony regularly migrated elsewhere at the end of each spring, Thomson decided to practice in the summer at St. Moritz in the Engadine. To do this it was necessary to possess a Swiss diploma, which he secured after two semesters of study at Lausanne. In spite of successful general practice in these two countries, he realized that it led to nothing. So, after these seven years he spent some months in Vienna, then in the height of its fame as the Mecca of medicine and also as the birthplace and leading school of laryngology. There he worked with von Schrötter, Stoerk and Hajek, as well as with the great otologist, Politzer. After a visit to the clinics of Freiburg, Frankfort and Paris, he settled in London in 1893. After these 10 wanderjahre, there came some lean years, which he filled by passing the Final F.R.C.S.; making the investigations at the Lister Institute which resulted in his researches on the "Microbes of the Normal Nose" and the "Defenses of the Air Passages"; lecturing at the Polyclinic; doing such clinical work after being appointed to the Royal Ear Hospital and the Throat Hospital (Golden Square); while sub-editing *The Practitioner* and helping to found the "National Association for the Prevention of Tuberculosis." These years of struggle were rewarded by his election to the Throat Department of King's College Hospital in 1901. But the hard work took its toll, for he had not been a year at work there when he developed tuberculosis and had to retreat to a sanatorium. As the larynx was also affected, and as he had been one of the first to insist that strict rest was as necessary a factor for arrest of disease of the vocal cords as in other secondary lesions of the body, so it was one of life's little ironies that he was probably the first patient in England to carry out the treatment of complete silence. He was dumb for six months. This check to his career was hardly overcome when he lost his wife—four years after marriage. He turned with greater energy to his clinic at King's College Hospital and to work at the Seaman's Hospital, which he had joined. Private practice soon prospered

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and was largely increased when he became the throat physician of King Edward VII, whom he attended during and up to the end of his last illness. His standing with the profession was shown by his election to the Fellowship of the Royal College of Physicians (1903) and was assured by the publication of his well known work on "Diseases of the Nose and Throat" (1911). This at once became a leading textbook, both in England and in America. At the College of Physicians he delivered the Mitchell Lecture on "Tuberculosis of the Larynx as a Prognostic Factor"; was awarded the Parker-Weber Medal and Prize, and served on the Council. In 1915-1916, while President of the Medical Society he delivered the inaugural address on "Lettsom and the Foundation of the Medical Society of London" and the annual oration on "Shakespeare and Medicine." He served the British Medical Association as President of the Section on Otolaryngology on no less than three occasions — in Belfast (1909), at the Centenary meeting in London in 1932, and in Winnipeg when he received an honorary LL.D. in 1930. The highest distinction in this line was his election as President of the Royal Society of Medicine for 1925-1927. The appreciation of this recognition of laryngology — hitherto rather the Cinderella of the specialties — was manifested by 175 of his colleagues in the same department of practice, who presented him with a silver loving cup to commemorate the event and as a recognition of his services to throat surgery. At the customary dinner accompanying the ceremony the recipient said that, like Rosencrantz, he held worldly ambition as of so airy and light a always nourished two ambitions: One was to till to the best of his ability the corner of the field of medicine in which he labored; and the other was to accomplish this in such a way as to retain the esteem and regard and, perhaps, the affection of his fellow-workers. In trying to do this he had followed Shakespeare's advice: "Do as adversaries do in law — strive mightily, but eat and drink as friends."

The esteem of his co-workers was again manifested in 1932 when the members of the Section on Laryngology presented him with his portrait. The president of the section, Mr. Wal-

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ter Howarth, in handing over the portrait, said\* that Sir St. Clair had been a pioneer of British laryngology and had devoted himself during laborious years to its advancement. Few things had contributed more to this than the researches and encyclopedic knowledge embodied in his well known textbook. He was more than a pioneer and a layer of foundations: he had been an ambassador. By his journeys abroad, his fluency in languages, his friendships with Continental and American laryngologists and his membership of foreign societies, he had established the recognition of British laryngology; above all, he had been the friend of brother laryngologists, a man of proverbial hospitality and one who had done much good anonymously.

Subsequent to his presidency of the Royal Society of Medicine, he was, for two years, president of the section on the History of Medicine and contributed papers on "Antimonyall Cuppes or Calices Vomitoria," the "Present Need of the History of Medicine" and "Enamel Miniatures of Celebrated Medical Men." He served as president of the Tuberculosis Association. For some years he was on the Council of Epsom College. He was the second President of the "Visiting Association of British Throat and Ear Surgeons," founded by Sir William Milligan and Mr. Musgrave Woodman, and with it visited the clinics of Paris, Berlin, Vienna, Brussels, Strasburg, Bordeaux, Stockholm, Copenhagen, Bristol, Birmingham, Manchester, Edinburgh and Glasgow. Berlin and Madrid were again visited during the International Congresses on Otolaryngology. He visited Canada and the United States on several occasions.

He was knighted in 1912, and was president of the section on laryngology at the last International Congresses of Medicine in London in 1913. He was called to Flanders in 1915 to attend the present King of the Belgians, and subsequently in London operated on the Queen Mother, Prince Charles and the present Crown Princess of Italy. For this he was made Officier de l'Ordre de Léopold. Later he was made Commendatore della Corona d'Italia. During the great war he served in France with the Croix Rouge Francaise, and in 1921

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\*Brit. Med. Jour., Nov. 12, 1932.

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became Chevalier de la Légion d'Honneur, being afterwards promoted Commandeur and, later, Officier. In 1929 he was elected one of the four British corresponding members of the Académie de Médecine, and enjoyed meeting friends at its gatherings during his visits to France, a country where he was much at home and which he also visited to carry out treatment at Vichy and Vitel for the recurring symptoms of gout. This inheritance he kept in check by great moderation of food and wine, though he had an appreciative taste and knowledge of both.

Never an athlete nor very vigorous, and somewhat critical of the value of competitive team games, he kept himself in condition by much fresh air, walking, rowing, riding, dancing and, he would add, "temperance in all things except sound sleep." He could be seen riding in the Row, Richmond Park, Epsom Downs, the New Forest, the commons round Midhurst, and the downs above Eastbourne; or in the Bois de Boulogne, the forest of Fontainebleau or Ghiberta (Biarritz), or the Alsatian hills round Vittel, until past his eightieth year. Every summer in recent years he took a holiday on the upper Thames, often sculling from Clifton Hampden to Abingdon and back. Dancing, particularly if it could be enjoyed in uninitiated air and in reasonable hours, he held to be the most ideal of all exercises and at all ages. His fondness for this diversion was evidenced by his introducing it, during his term of office, at one of the soirées of the Royal Society of Medicine. When, on one occasion, the guest at a laryngological dinner, it leaked out that the following verse was well known among his juniors:

"My name is St. Clair,  
They say I've a flair  
For the nose and the throat and the ear.  
For my op of thyrotomy  
The world thinks a lot of me,  
But, — give me a dance and good cheer!"

Always fond of the drama, music and literature, he was, in former days, honorary laryngologist to the Actors and to the Music Hall Associations and, for some years, he was physician to the Royal Italian Opera.

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Sir St. Clair was fortunate in living in a spacious old Georgian house which served well for the tasteful display of his collection of objets d'art. Here friends and colleagues were welcomed at all times, particularly when associated with gatherings in which he happened to hold office, or, during the Great War, or for students' concerts, or at the "Hogmanay Dances" with which, during many years, his young friends welcomed in the New Year. Here there was light and space for old color prints and Chippendale mirrors on the walls; Georgian silver and china, old glass and French wine-tasters on the mahogany tables or Sheraton sideboards; and Chippendale cabinets for Lambeth or Majolica pharmacy jars, miniatures and enamels. Some of the prints Rowlandson water colors, silver and Lambeth drug jars have found their way into professional institutions and we understand that a unique collection of color prints of Shakespeare subjects has been given to the Theatre at Stratford-on-Avon, while one of the largest private collections of rare Majolica pharmacy jars has been left to the Victoria and Albert Museum.

During the Battle of Britain his home was partly demolished by German bombs and he retired to Edinburgh, where he spent his remaining days.

He was a great reader, both of English and French literature, and a stickler for the conservation and the purity of the English language, both written and spoken. His now classical textbook is a model of the clarity and charm with which a scientific textbook can be written. It contains, naturally, a digest of his own special contributions to the two subjects in which he did the most work, *viz.*, tuberculosis and cancer of the larynx. The latter subject was also dealt with fully in a manual written in association with Mr. Lionel Colledge. In a leading article in a medical journal on his book on "Cerebrospinal Rhinorrhea" he was given such full credit for establishing this affection as a morbid entity that the writer opined that, in another country, it would doubtless have been called "die Thomson'sche Krankheit."

The opportunities afforded by nearly 30 years of devoted service at King Edward VII Sanatorium resulted in a pub-

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lication by the National Research Council. This demonstrated the importance of studying the larynx in all cases of tuberculosis and insisted on recognizing the disease there as a secondary infection and on treating it chiefly by strict rest, thus arresting the extensive and generally harmful local measures formerly in use.

In his life and works Sir St. Clair did much to prove that the genuine specialist should know something of all departments and everything of one. In the same spirit, he was a many-sided man and warmed both hands before the fire of life. His personality as well as his professional wisdom and experience are so enshrined in his textbook that it well illustrates Buffon's aphorism "le style c'est l'homme." In it he continued the old custom of prefacing each edition with a quotation from some well known author. The first edition defended the necessity for textbooks by the aphorism of Osler: "To study the phenomena of disease without books is to sail an uncharted sea; while to study books without patients is never to go to sea at all." For the justification and the basis of specialism, he quotes A. Coutry: "La spécialité est le degré le plus bas de l'art, lorsqu'elle n'est pas fécondée par les connaissances générales; elle en est la perfection, lorsqu'elle est le couronnement de la science. Il faut finir au lieu de débuter par elle." The immediate success of the book encouraged the text for the second edition. "Un livre est toujours un moyen de faire un meilleur livre" (Michelet). A justifiable satisfaction warranted, for the next edition, a quotation from Samuel Johnson's preface to his great dictionary: "In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed." Finally, in the preface of the last edition (1937) he left the work to his pupils with the words of Bacon: "Were it not better for a man in a fair room to set up one great light than to go about with a rush light into every dark corner." And he took farewell with a sentence from Montaigne: "J'ay fait ce qu j'ai voulu; tout le monde me reconnoit en mon livre, et mon livre en moi." As an American reviewer of the book wrote: "No man could wish a fairer memorial."

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### BOOK REVIEW.

**Manual of Oxygen Therapy Techniques including Carbon Dioxide, Helium and Water Vapor.** By Albert H. Andrews, Jr., M.D., Director, Oxygen Therapy Department, and Assistant Attending Otolaryngologist, St. Luke's Hospital, Chicago; Instructor in Laryngology, Rhinology and Otology (Broncho-Esophagology), University of Illinois College of Medicine; Associate Attending Bronchoesophagologist, Children's Memorial Hospital, Chicago; former Research Instructor, Department of Physiology and Pharmacology, Northwestern University Medical School. With 191 pages and 33 illustrations. Chicago: The Year Book Publishers, 304 South Dearborn Street, 1943. Price \$1.75.

This small manual omits nothing of value to those employing gas therapy. The illustrations are well chosen and there is information not only on the use of gases but also on the maintenance and relative merits of various apparatus.

This book is recommended as a complete ready reference for all those who have occasion to use gas therapy.

T. E. W.

## DIRECTORY OF NATIONAL OTOLARYNGOLOGIC SOCIETIES.

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Chairman: Dr. Claude C. Cody, 1304 Walker Ave., Houston.  
Secretary: Dr. Louis H. Clerf, 1530 Locust Street, Philadelphia.  
Place: San Francisco.

### **American Academy of Ophthalmology and Otolaryngology.**

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